DRAFT CORRECTIVE ACTION PLAN
THREE USTS NEAR FORMER BUILDING 4

FEDERAL CENTER
607 HARDESTY AVENUE, KANSAS CITY, MO

Missouri DNR ST# 10970

Spill # 000309-0815-NRB Jackson County

Contract No.: GS06P98GYC0012

GSA Project No.: RMO20490

Prepared for:

GENERAL SERVICES ADMINISTRATION

Property Management Division, Technical Support Branch (6PMT-E)
1500 East Bannister Road, Room 2135
Kansas City, Missouri 64131-3088

Prepared by:

CAPE
ENVIRONMENTAL
MANAGEMENT
INC

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MARCH 2002

STATE OF MISSOURI
Bob Holden, Governor • Stephen M. Mahfood, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.state.mo.us

February 24, 2003

Mr. David Hartshorn
General Services Administration
1500 Bannister Road, Room 2135
Kansas City, MO 64131-3088

RE: Federal Center Facility, 607 Hardesty Avenue, Kansas City, Missouri

Dear Mr. Hartshorn:

I received your email on February 20, 2003, regarding the approval of the Lead Abatement Plan, Building 4 Underground Storage Tanks (UST) and Building 3A USTs. These remedial action plans will be utilized to show potential buyers the Missouri Department of Natural Resources (department) has reviewed and approved these plans.

The lead abatement plan does not list the dimensions or size of the firing range. These dimensions are listed in the Site Inspection report. Please provide a diagram of the firing range with the dimensions drawn on the diagram. Were the walls tested to see if lead contamination is in the paint? The site inspection report states the walls are painted cinder blocks. If the paint is lead based the sampling results may be erroneous. Otherwise the work plan is approved for implementation.

The Building 4 Underground Storage Tanks are regulated tanks. This plan was submitted to the Tanks Section of the department. Mr. Eric Tse, Project manager in the Tanks Section, asked me to oversee this plan as well as the unregulated tanks at this site. He has no objections to the draft remedial action plan as written. This remedial action plan is also approved for implementation.

The Building 3A Underground Storage Tanks are unregulated tanks. The Voluntary Cleanup Program (VCP) has been providing oversight of these tanks. The required plans as outlined in Section 7.4 of the remedial action plan will need to be submitted and approved by the VCP prior to any field activities. An underground injection permit will also need to be submitted to the Water Pollution Control Program (WPCP) prior to remediation. It takes time to acquire an injection permit from WPCP so please allow adequate time before remediation. This draft remedial action plan for the three USTs near Building 3A is approved for implementation.

The department is aware a prospective purchaser may conduct the remediation as outlined in the Early Transfer Authority and Covenant Deferral Request. The VCP would like to be notified as soon as possible if a potential buyer for the site proposes doing the remediation. The final remedial action plan would need to be submitted by the person doing the remediation. This plan may be different than the one outlined by the draft remedial action plan.

If you have any questions please contact me at 573-761-7538 or P.O. Box 176, Jefferson City, Missouri 65102-0176.

Sincerely,

HAZARDOUS WASTE PROGRAM

Christine O'Keefe

Christine O'Keefe
Environmental Specialist
Voluntary Cleanup Section

CO:ph

Table of Contents

List of Tables

List of Figures

Appendices

List of Acronyms

bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAP	Corrective Action Plan
CAPE	Cape Environmental Management Inc.
CDR	Covenant Deferral Request
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CMA	Corrective Measures Alternative
CMS	Corrective Measures Study
COC	Contaminant of Concern
°C	Degrees Celsius
DGLS	Missouri Division of Geology and Land Survey
ETA	Early Transfer Authority
gpm	Gallons per Minute
GRH	Gasoline Range Hydrocarbons
GSA	General Services Administration
HSA	Hollow Stem Auger
LPCA	Liquid Phase Carbon Adsorption
µg/L	Micrograms per Liter
MCL	US EPA Maximum Contaminant Level
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MO DNR	Missouri Department of Natural Resources
MTBE	Methyl Tert-Butyl Ether
MW	Monitoring Well

ND	Not Detected
NPL	National Priorities List
O&M	Operation and Maintenance
OMB	Office of Management and Budget
ORC	Oxygen Release Compound
PID	Photoionization Detector
ppm	Parts per Million
PTA	Property Transfer Agreement
RA	Response Action
RFH	Radio Frequency Heating
SB	Soil Boring
SCR	Site Characterization Report
SVE	Soil Vapor Extraction
SVOC	Semivolatile Organic Compound
TEH	Total Extractable Hydrocarbons
UIC	Underground Injection Control
USDW	Underground Sources of Drinking Water
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WPCP	Water Pollution Control Program

1.0 INTRODUCTION

1.1 Purpose

The General Services Administration (GSA) has completed a site characterization at the Federal Center located at 607 Hardesty Avenue, Kansas City, in Jackson County, Missouri (site). Contamination is present at the site in concentrations that exceed Missouri Department of Natural Resources (MO DNR) cleanup levels for soil and groundwater. As a result this Corrective Action Plan (CAP) is prepared to present corrective measure objectives for soil and groundwater impacted by release(s) from three closed underground storage tanks (UST). The three former USTs were located near Building 4, which has been demolished. This CAP presents current site information, provides a Corrective Measures Study (CMS), recommends corrective actions in response to contamination at the site, and provides a conceptual design for corrective actions. Additionally, this CAP and the recommended corrective actions for soil and groundwater contamination, once approved by the MO DNR, will be part of an Early Transfer Authority (ETA) package that will be presented to the Governor of Missouri. The GSA intends to present the ETA package to the Governor in order to transfer ownership of the property as soon as possible. The process of early property transfer is a means where federal properties can be sold provided that an approved CAP for the property is in place and the government is pursuing funding for the implementation of the CAP. Specifics with respect to the ETA process are presented below.

1.2 Early Transfer Authority

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) contains a covenant that requires the federal government to perform all remedial action necessary to protect human health and the environment prior to transfer. However, Section 120(h)(3)(C) allows landholding agencies to request deferral of the CERCLA covenant through the ETA program. Congress authorized ETA in the Fiscal Year 1997 Department of Defense Authorization Bill, amending CERCLA. As long as safeguards are in place to protect human health and the environment, ETA allows the federal government to transfer property to non-federal entities before the completion of environmental cleanup. The governor of the state in which the property is located must concur that the property is suitable for early transfer. Since ETA's enactment, federal properties have been successfully conveyed to local communities prior to the completion of environmental cleanup. These early transfers met local communities' needs for expedited property transfer, reduced customer agencies' protection and maintenance costs, and ensured for the protection of human health and the environment.

Before Congress enacted ETA, CERCLA required the federal government to complete all necessary cleanup actions on a property before transferring title out of government ownership. Federal funding for the property's environmental cleanup often proved difficult to obtain and insufficient to meet cleanup costs. While waiting for the government to finish remediation, potential new owners faced difficulties trying to obtain financing and structure deals. As a result some property transfers took years to execute, delaying restoration and redevelopment.

Early transfer provides the opportunity for simultaneous cleanup and redevelopment. Marrying remediation with redevelopment often proves to be extremely cost-effectiveness as it enables the cleanup remedy to be designed with the final site reuse in mind.

Early transfer also allows for privatization of cleanup. For example, the transferee or a developer may perform the remediation in exchange for a reduced purchase price. This may be extremely beneficial in certain cases. Private developers often have greater incentive, experience, and funding to complete environmental cleanup. A non-federal entity may also purchase insurance to address environmental risks and assure the availability of funds for unexpected cleanup costs.

ETA is presented in this CAP as part of the overall recommended corrective measure for the site. ETA is discussed more specifically in Subsection 4.2.2.

1.3 Site Background

The site is a federal property located at 607 Hardesty Avenue, Kansas City, in Jackson County, Missouri. The Federal Center consists of seven buildings with associated parking areas located on approximately 18 acres of land. The site was reportedly acquired by the Department of Army in 1940 and was developed as a supply depot to support military operations. Currently, GSA owns the site. During the period of supply depot operations several USTs were present on the site to support the military operations. After World War II, depot functions declined and several of the buildings and associated USTs have been demolished, abandoned, and/or removed.

1.4 Site Location and History

The site occupies an area of approximately one city block within a business district northeast of downtown Kansas City. Independence Avenue borders the site to the north, the Kansas City Terminal Railroad to the East and South, and Hardesty Avenue to the West. The 7.5-minute United States Geological Survey (USGS) Kansas City quadrangle map for the site and the surroundings is provided in Figure 1. A Site Map is included in Figure 2.

The site was developed incrementally throughout the period of 1940 through 1960. The site was reportedly acquired by the Department of Army in 1940 and was developed as a supply depot to support military operations. Development included the addition of numerous buildings, approximately nine USTs, and a service station. After World War II, depot functions declined and several of the buildings and associated USTs have been demolished or removed.

This CAP addresses contamination associated with the following three former USTs:

- Two 1,000-gallon steel USTs near former Building 4 that were removed by Cape Environmental Management Inc (CAPE) in March 2000
- One 560-gallon steel UST near former Building 4 that was removed by CAPE in March 2000.

During the initial UST removal at Former Building 4 in March 2000, approximately 2,600 cubic yards of petroleum-contaminated soils were excavated and disposed off site. After the initial UST Closure Assessment (CAPE, 2001) at the former Building 4 UST locations, MO DNR required that GSA conduct a site characterization to adequately define the horizontal and vertical extent of contamination.

The site characterization field activities were conducted between November 27, 2000 to December 8, 2000. The field activities focused on the installation of Geoprobe® borings for both soil screening and the collection of soil samples in suspected source areas. In addition, soil samples were collected to delineate the contaminated area. The investigation also focused on the installation of permanent groundwater monitoring wells (MW) using truck-mounted drill rigs equipped with hollow stem augers (HSA). The overall objective of the site characterization was to adequately define the horizontal and vertical extent of contamination near Former Building 4. These objectives were met and recommendations in the Site Characterization Report (CAPE, April 2001) included the development of a CAP for this area.

Based on the findings of the site characterization, CAPE is submitting this CAP for the three former USTs located near Building 4.

1.5 Scope of the Corrective Action

This CAP addresses contamination in soil and groundwater associated with three closed USTs near Building 4. The scope of the CAP is to utilize site-specific information from relevant site investigations to formulate site corrective action objectives and to evaluate various response actions appropriate for achieving the objectives. Based on this evaluation, the CAP provides a recommended corrective action alternative and outlines a conceptual design and implementation plan for the selected alternative.

This CAP was prepared following the MO DNR Underground Storage Tank Corrective Guidance Document (MO DNR, 1992). The Missouri Corrective Action Plan Checklist, required by the MO DNR guidance, is included in Appendix A.

1.6 Environmental Setting

1.6.1 Regional Geology

The Federal Center is located in Jackson County, Kansas City, Missouri. Jackson County is located near the middle of an approximately 150-mile wide, north-south trending band of Pennsylvanian Age rocks which stretched from western Missouri to eastern Kansas. The beds exhibit a subtle prevailing dip to the west-northwest. The region is underlain by rock units of the Pennsylvanian System and the Missourian Series (Kansas City Group and Pleasanton Group) in the Time Stratigraphic Unit age classification. Alternating layers of shales and limestone with an associated sandstone layer are common in the Kansas City Group.

Jackson County is located in the Saline Groundwater Province. In the upland area above the alluvial valleys of the Missouri River, the Blue River, and the Little River, the unconsolidated sediment is typically deficient of groundwater. Jackson County is underlain by bedrock aquifers at depths of 250 to 400 feet that contain saline water, which coincides with the presence of Pennsylvanian rocks. Due to the fact that the Jackson County is located in the Saline Groundwater Province, the main supply of water for domestic usage is from the alluvium of the Missouri River or from the surface impoundments within the localized watershed. Figure 7 presents the potentiometric surface map for the site. Figure 8 presents the geologic cross section of the site.

1.6.2 Demography and Land Use

The site occupies an area of approximately one city block within a business district northeast of downtown Kansas City. Land use surrounding the site is a mix of light commercial and residential properties.

The Federal Center currently encompasses seven buildings with associated parking areas located on approximately 18 acres of land. Most of the buildings are unoccupied, empty, and/or used for storage. The Federal Aviation Administration currently occupies Building 6, but their lease expired at the end of November 2001.

1.6.3 Site Geology

Soil types on site vary from coarse-grained backfill soils to fine-grained native soils. Backfill materials are present from surface to 4 feet bgs, silty clay from 4 feet to 12 feet bgs, fine clay from 12 feet to 24 feet bgs, and inorganic clays from 24 feet to 40 feet bgs. At the ground surface, soils were silty gravel (unified soil classification group symbol "GM") that are black in color with no moisture to inorganic clays (unified soil classification group symbol "CH") that are light brown in color, highly moist, and highly plastic at 40 feet bgs.

1.6.4 Site Hydrogeology

Jackson County is underlain by bedrock aquifers at depths of 250 to 400 feet that contain saline water that coincides with the presence of Pennsylvanian rocks. Total thickness of the aquifer ranges from 1,200 to more than 4,000 feet. Due to the fact that Jackson County is located in the Saline Groundwater Province, the main supply of water for domestic usage is from the alluvium of the Missouri River. Some of the localities obtain groundwater from other lesser rivers that flow into the Missouri River or from surface impoundments within the local watershed.

Upon completing the groundwater sampling activities and surveying activities, aquifer testing was performed on December 7, 2000. Limited aquifer testing was performed in monitoring well MW-3 as part of the site characterization activities. Detailed information regarding the site characterization is presented in Section 2.0.

The calculated average hydraulic gradient at the site was 0.0075 feet per feet. Two slug tests were performed in monitoring well MW-3. The data collected from these two tests were used to estimate the hydraulic conductivity using the Hvorslev Method. The estimated hydraulic conductivity for the site is 2.4×10^{-3} feet per day. Using Darcy's Law, the calculated hydraulic gradient, and the hydraulic conductivity, the seepage velocity is estimated to be approximately 3×10^{-2} feet/year. The hydraulic conductivity data and calculations are presented in Appendix C.

2.0 BACKGROUND

2.1 Site Characterization Summary

Several site characterization efforts were conducted that are relevant to this CAP. Site characterization field activities near Building 4 were conducted from November 27, 2000 to December 8, 2000. These site characterization field activities were initially directed at characterizing the former Building 4 UST area, based on recommendations from the UST Closure Assessment performed by CAPE in June 2000. The following sections present details of the site characterization efforts that relate to the three former UST locations addressed in this CAP.

2.1.1 Soil Borings

Soil borings (SB) were installed at Building 4 to collect samples for site characterization efforts. The locations of these samples are presented in Figure 3.

A total of 23 soil borings, SB01 through SB23, were installed to depths ranging from 20 to 40 feet bgs in the vicinity of the former Building 4. Based on the background information (field data collected during UST Closure Assessment) soil borings during the site characterization activities were installed at the following locations:

- 3 soil borings (SB01, SB02, and SB03) were installed along the north-northeast end of the UST excavation area of suspected worst case contamination based on the UST Closure Assessment
- 2 soil borings (SB04 and SB17) were installed along the north side of the UST excavation to horizontally delineate the subsurface contamination in that direction
- 1 soil boring (SB18) was installed along the northwest side of the UST excavation near the sanitary sewer line to determine if the subsurface contamination was transported by the utility line
- 14 soil borings (SB06-SB09, SB12-SB16, and SB19-SB23) were installed along the northeast side of the UST excavation to horizontally delineate the subsurface contamination in the estimated groundwater flow direction
- 3 soil borings (SB05, SB10, and SB11) were installed along the southeast side of the UST excavation to horizontally delineate the subsurface contamination in that direction.

Soil boring locations near former Building 4 are presented in Figure 3. A total of 31 soil samples were collected from the locations listed above for analysis using Iowa OA1 and OA2 methods. The former USTs at former Building 4 had a potential for carrying leaded gasoline during their operational period. Six soil samples [HAR-SB03 (31-35), HAR-SB04 (28-32), HAR-SB06 (16-20), HAR-SB07 (36-40), HAR-SB12 (20-24) and HAR-SB13 (20-24)] were collected for TCLP-Lead analysis to document the concentrations of lead leaching into groundwater, if any.

No soil borings were installed on south and west sides of the former USTs at Building 4 during these site characterization activities. Soil borings designated P2 and P4 were installed just outside the excavation pit on west and south sides of the former USTs during initial UST Closure Activities. Field screening results of the soil samples collected from soil borings P2 and P4 indicated 1 parts per million (ppm) and 12 ppm respectively. Based on these two soil boring field screening results and the estimated groundwater flow direction in northeast of the former tanks, it was concluded that the residual contamination at the former UST location is in the direction of the groundwater flow. Hence, no additional soil borings were installed on west and south sides of the former USTs during these site characterization activities.

2.1.2 Monitoring Well Installation

Groundwater monitoring wells were installed at Building 4 to collect samples for site characterization efforts. The locations of these monitoring wells are presented in Figure 5.

A total of four groundwater monitoring wells (MW1 through MW4) were installed during the December 2000 site characterization in the vicinity of the Former Building 4. Field screening data from the soil borings were used to guide placement of monitoring wells to horizontally and vertically delineate subsurface contamination. Based on the background information and the field screening data, monitoring wells were installed at the following locations near the former Building 4:

- Monitoring well (MW1) was installed at the north-northeast side of the former UST excavation pit at the worst case contamination location

- Monitoring well (MW2) was installed directly north of the former Building 4 UST excavation pit near Building 7 to delineate the subsurface contamination in north direction
- Monitoring well (MW3) was installed at north-northeast of the former Building 4 UST excavation pit near Building 9 to delineate the subsurface contamination in the direction of the groundwater flow
- Monitoring well (MW4) was installed at north-northeast of the former Building 4 UST excavation pit in the asphalt driveway to horizontally delineate the subsurface contamination.

2.1.3 Ground Penetrating Radar Survey

The Hardesty site has been in the Federal Registry of Properties for many years. As a result, various versions of building plans were available for review during the course of the project. As a result of reviewing the plans, suspect tank locations were identified based on these plans northwest of Building 3 and west of Building 3A. In order to confirm or deny the presence of USTs at these locations a GPR survey was conducted on November 14, 2001 and November 20, 2001 along the perimeter of Buildings 3 and 3A. No USTs were identified. Results of the GPR Survey indicated no significant subsurface anomalies. These results suggest that no USTs remain in the suspected areas.

2.2 Site Characterization Findings

2.2.1 Soil Samples

A total of 31 soil samples collected near Building 4 were analyzed for volatile organic compounds (VOCs) and total extractable hydrocarbons (TEH) using Iowa Method OA1 and OA2. Method OA1 includes laboratory analysis for mineral spirits, jet fuel, kerosene, diesel fuel, fuel oil, and motor oil. Method OA2 includes laboratory analysis for gasoline-range hydrocarbons (GRH); benzene, toluene, ethylbenzene, and xylene (BTEX); and methyl tert-butyl ether (MTBE). Laboratory analytical results for the soil samples are summarized in Table 1. Soil samples with corresponding laboratory analytical results are plotted on Figure 4.

Laboratory analytical results of the soil samples collected in the vicinity of the former Building 4 USTs indicated concentrations of GRH and BTEX constituents above the laboratory reporting levels. No other constituents analyzed for under OA1 or OA2 were reported. An evaluation of the sample analytical results is provided below:

- Concentrations of GRH exceeded the site cleanup level of 200 milligra per kilogram (mg/kg) of TPH (which includes GRH) in seven soil samples. Concentrations of GRH at or above the cleanup level in soil samples ranged from 200 mg/kg [HAR-SB13 (8-12)] to 1,800 mg/kg [HAR-SB03 (7-11)].
- Concentrations of benzene exceeded the site cleanup level of 1 mg/kg in two soil samples. Soil samples HAR-SB03 (7-11) and HAR-SB20 (12-16) indicated concentrations of benzene at 3.8 mg/kg and 1.4 mg/kg, respectively.
- Concentrations of toluene were below the site cleanup level of 5 mg/kg in all soil samples.
- Concentrations of ethylbenzene exceeded the site cleanup level of 10 mg/kg in two soil samples. Concentrations of ethylbenzene were indicated in soil samples HAR-SB03 (7-11) and HAR-SB20 (12-16) at 30 mg/kg and 18 mg/kg, respectively.
- Concentrations of xylenes exceeded the site cleanup level of 10 mg/kg in two soil samples. Soil samples HAR-SB03 (7-11) and HAR SB20 (12-16) indicated concentrations of xylenes at 76 mg/kg and 13 mg/kg respectively.

2.2.2 Groundwater Samples

A total of four groundwater samples collected near former Building 4 were analyzed under OA1 and OA2 methods. Laboratory analytical results for the groundwater samples are summarized in Table 2. Monitoring wells and corresponding groundwater sample results are plotted on Figure 6.

Laboratory analytical results of the groundwater samples collected from the monitoring wells installed at the former Building 4 USTs indicated concentrations of GRH, BTEX constituents, and MTBE at or above the laboratory reporting limits. The following presents the detected concentrations of GRH, BTEX constituents, and MTBE in groundwater at Former Building 4 USTs:

- GRH was detected in groundwater sample HAR-MW1 at 12,600 micrograms per liter (µg/l). This concentration is above the MO DNR groundwater cleanup level of 10,000 µg/l.
- Benzene was detected in groundwater sample HAR-MW1 at 1,620 µg/l. This concentration is above the MO DNR groundwater cleanup level of 50 µg/l.

- Toluene was detected in groundwater sample HAR-MW1 at 242 µg/l. This concentration is above the MO DNR groundwater cleanup level of 150 µg/l.
- Ethylbenzene was detected in groundwater sample HAR-MW1 at 829 µg/l. This concentration is above the MO DNR groundwater cleanup level of 320 µg/l.
- Xylene (total) was detected in groundwater sample HAR-MW1 at 1,080 µg/l. This concentration is above the MO DNR groundwater cleanup level of 320 µg/l.
- MTBE was not detected above the MO DNR groundwater cleanup level of 400 µg/l.

Groundwater contamination that exceeds the MO DNR Underground Storage Tank Corrective Guidance Document groundwater cleanup levels are concentrated around HAR-MW1.

2.2.3 *Estimated Local Groundwater Flow Direction*

After completing the monitoring well installation activities, the relative elevation of the casing top of each well was determined. Groundwater elevation measurements were measured from the casing top. Using this groundwater elevation data, a potentiometric surface map was developed. The estimated potentiometric surface at the time that water level measurements were collected is presented as Figure 7. Groundwater elevations were measured in nine monitoring wells using a water level indicator. At the time groundwater elevation measurements were collected, groundwater was encountered at elevations of 774.19 in MW1 to 770.99 in MW5. Groundwater is estimated to be flowing north-northeast. Due to the previous work performed at the site (i.e., extensive excavation in clay materials to a depth of up to 35 feet) the estimated groundwater flow direction is likely to be representative of the sandy unit below the clayey soils at approximately 20 feet bgs.

2.2.4 *Extent of Contamination*

Contamination associated with the three closed USTs has adversely impacted soils in an approximate area of 6,500 square feet of the 18-acre site. Soil contamination in this area extends from primarily from four feet bgs to 16 feet bgs. An estimated volume of approximately 4,300 cubic yards (6,500 tons) of impacted soil is present. The estimated extent of soil contamination is shown on Figure 9.

Groundwater contamination has been horizontally delineated in the central portion of the site. Groundwater contamination does not extend offsite.

2.3 Potential Receptors

Underground utilities near Building 4 run north to south on the westside of the UST closure excavation and on the northern edge of the excavation a storm sewer line runs east to west. There are steam utility lines running north to south from Building 7 to the former location of Building 4. The storm sewer line was exposed at 6 feet bgs on the north wall of the excavation and three grab samples were collected from the fill material beneath this utility line. The three samples that were analyzed for BTEX and TPH and concentrations are above the UST Soil Cleanup Guidelines (Table 3: MO DRN, February 1992). Additional utility lines are present to the east and west of the excavation. These utility lines may have provided preferential pathways for contaminant transport. However, during the site characterization soil was sampled at 16 to 20 feet bgs on the downgradient end of the storm sewer. The analytical results were below detection levels for all constituents.

The closest receptor is a creek 1,100 feet north of the property. A second creek is located 2,250 feet northeast of the site. It is unlikely that the contaminants will impact either creek.

Considering the depth of soil contamination, it is unlikely that human receptors are currently exposed to subsurface soil contamination in the current time frame. The site has controlled access and digging in the area is not permitted without approval from GSA.

A private and public well survey of the area did not identify any drinking water wells within ½ mile of the site. According to the Kansas City Water Services Department, drinking water is supplied by the public water system to all residences in the vicinity of the site. Additionally, it is unlikely that human receptors would be exposed to contaminated groundwater considering that the plume is relatively immobile, has not migrated off site, and the installation of on-site shallow aquifer drinking water wells would not be permitted under current site controls. The contaminated groundwater is confined to a geologic unit that is not currently used for drinking water in the areas downgradient of the site.

A change in land ownership could result in potential exposures to human receptors through on site digging/excavating and the installation of drinking water wells in the contaminated aquifer.

3.0 CORRECTIVE MEASURE OBJECTIVES

3.1 Purpose

Corrective measure objectives for this site are developed to protect human health and the environment through media-specific actions. The corrective measure objectives specify the media-specific contaminants of concern (COC), exposure pathways and receptors, and an acceptable concentration (i.e., cleanup level) to address COCs. Corrective measure objectives presented in this CAP provide a general description of what the corrective measure will accomplish for a specific media.

Based on the information provided in the site characterization report, the media of concern at the site are the groundwater and subsurface soils. The COCs for subsurface soil are TPH (in the form of GRH), benzene, ethylbenzene, and xylene. Potential exposure pathways for subsurface soil include direct exposure to humans through dermal contact and inhalation (dust and volatilized contaminants) as a result of digging and excavating activities. The COCs for groundwater are TPH (in the form of GRH) and BTEX. Potential exposure pathways for groundwater include direct exposure to humans through dermal contact, ingestion, and inhalation (volatilized contaminants) as a result of the installation of wells. Soil contamination is also present at levels that could impact groundwater quality through soil-to-groundwater contaminant leaching. Due to the localized area, the relative immobility of groundwater contamination (seepage velocity approximately 0.03 feet/year), and the presence of soil contamination below the surface, there are no potential exposure pathways to environmental receptors. The acceptable concentrations (cleanup levels) for the COCs are the MO DNR soil and groundwater cleanup levels (MO DNR, 1992).

3.2 Establishment of Remediation Levels

Based on the site sensitivity score for the Hardesty site (Appendix B), appropriate soil cleanup levels and groundwater cleanup levels are listed in the following subsections:

3.2.1 Soil Cleanup Levels

The MO DNR Underground Storage Tank Corrective Guidance Document soil cleanup levels for the site are:

- benzene - 1 mg/kg
- toluene - 5 mg/kg
- ethylbenzene - 10 mg/kg
- xylenes - 10 mg/kg
- TPH (including GRH) - 200 mg/kg.

Analytical results for soil samples at former Building 4 indicated the presence of TPH (in the form of GRH), benzene, ethylbenzene, and xylene above cleanup levels. These concentrations in soil at former Building 4 represent potential for human exposure in the event of construction or excavation at the site. Additionally, the concentrations in soil represent a source of contamination that can adversely impact groundwater quality. The corrective measure objective for soil will address these potential exposure pathways.

3.2.2 Groundwater Cleanup Levels

Groundwater cleanup levels published in MO DNR Underground Storage Tank Corrective Guidance Document are:

- benzene - 50 µg/L
- toluene - 150 µg/L
- ethylbenzene - 320 µg/L
- xylenes - 320 µg/L
- total BTEX - 750 µg/L
- TPH (including GRH) - 10,000 µg/L

Analytical results for groundwater samples at former Building 4 indicated the presence of GRH and BTEX constituents above cleanup levels. The groundwater contamination at former Building 4 does represent a potential for human exposure via exposure to contaminated groundwater during excavation or construction and exposure in the event that impacted groundwater is extracted. The corrective measure objective for groundwater will address these potential exposure pathways.

3.3 Corrective Measure Objectives

Based on the purpose of the corrective measures and the cleanup levels that were identified for the site, the following corrective measure objectives are defined for the site:

3.3.1 Remediation of Soil

Corrective measure alternatives will be developed that focus on remediating soil contamination at Building 4 to the MO DNR cleanup levels for TPH (GRH) and BTEX constituents.

3.3.2 Remediation of Groundwater

Corrective measure alternatives will be developed that focus on remediating groundwater contamination at Building 4 to the MO DNR cleanup levels for TPH (GRH) and BTEX constituents.

4.0 Identification and Screening of Technologies

This section consists of the first part of the CMS that is the identification and screening of technologies applicable to each general response action. Response actions (RA) are actions used to achieve the corrective measure objectives. This section identifies remedial technologies that are potentially relevant for achieving the corrective measure objectives at the site. The remedial technologies are evaluated with respect to their general ability to protect human health and the environment, applicability to site conditions, and potential limitations. Remedial technology options that pass the initial screening phase will be retained for possible inclusion during the development of corrective measure alternatives in Section 5.0. In Section 6.0, the corrective measure alternatives will be evaluated with respect to effectiveness, implementability, and cost. Based on this evaluation, an alternative or combination of alternatives will be selected for implementation for each media of concern.

4.1 Response Actions

To achieve the corrective measure objectives presented in Section 3.0, general RAs for groundwater and soil have been developed. These RAs will be used in the assessment of technologies and in the development of corrective measure alternatives. Each RA and its subsequent remedial technologies are discussed in this section. The RAs for groundwater and soil are presented below.

Groundwater Response Actions and Associated Remedial Technologies

Response Action	Remedial Technologies
No Action	None
Institutional Controls	Deed Assurances, ETA
Groundwater Monitoring	Groundwater Monitoring
Hydraulic Containment	Extraction
Groundwater Treatment	Physical Biological

Soil Response Actions and Associated Remedial Technologies

Response Action	Remedial Technologies
No Action	None
Institutional Controls	Deed Assurance, ETA
Excavation	Excavation and Off-Site Disposal
In-situ Treatment	Physical Biological

4.2 Groundwater Response Actions and Associated Technologies

4.2.1 No Action

The no action option is based on the lack of implementation of any corrective measure alternatives at the site. This option does not take steps to reduce contamination and does not provide protection of human health and the environment.

Applicability

No active steps would be taken to implement or document contaminant reduction or protection of human health and the environment. However, this RA is considered in this CAP so that a comparison can be made between taking no action at the site and implementing various alternatives.

Limitations

No action does not reduce contamination and does not provide long-term protection of human health and the environment.

Feasibility

Because no steps or processes are required for no action it is feasible to implement.

No action will be retained for further consideration as a basis for comparison with other technologies/alternatives.

4.2.2 Institutional Controls

Institutional controls are those actions that will control groundwater use and site access through public agencies or records. Institutional controls do not have a direct bearing on site restoration (i.e., not an active form of remediation) but reduce the potential for human exposure. Institutional controls for the purpose of this CAP will implemented through requirements of ETA, CERCLA Section 120(h)(3) (transfer of federal property by deed before all necessary remedial action has been taken).

ETA allows for the deferral of the required CERCLA deed covenant that states that "all remedial action necessary to protect human health and the environment has been completed prior to property transfer." The federal landholding agency assembles a Covenant Deferral Request (CDR) package to formally request deferral of the CERCLA covenant until completion of cleanup. The governor of the state and, when the property is a National Priorities List (NPL) site, the Environmental Protection Agency (US EPA) Administrator, must determine that the property is suitable for early transfer. In this case, the site is not an NPL site and only the Governor of Missouri would be involved. Suitability for early transfer is evaluated on the following criteria:

- The intended reuse is consistent with the protection of human health and the environment
- The deed or other agreement proposed to govern the transfer contains assurances that provide:
    - any necessary use restrictions will ensure the protection of human health and the environment by restricting groundwater use at the site
    - any necessary use restrictions will ensure that required cleanup actions will not be disrupted
    - that all necessary response action will be taken and identify the schedule for investigation and completion of all necessary response action as approved by the appropriate regulatory agency
    - that the federal agency responsible for the property will submit a budget request to the Office of Management and Budget (OMB) that adequately addresses schedules for investigation and completion of all necessary

response action subject to Congressional authorizations and appropriations.

- The deferral of the covenant will not substantially delay any necessary response action on the property
- The public was given notice and allowed at least 30 days to review and comment on the suitability of the property for early transfer.

4.2.2.1 Groundwater Use Restrictions

Placing groundwater restrictions on the property would involve the documentation of the restrictions with the Jackson County Records Department. The Jackson County Records Department would restrict the installation of shallow groundwater extraction wells in or near the existing groundwater contamination. This would be important for protection of human health for reasons such as preventing the installation of a drinking water well on the property.

Deed recordation other than the transfer agreement specified within ETA would also be used to establish groundwater use restrictions. The deed recordation or transfer agreement would, in perpetuity, notify any potential purchaser of the property that groundwater contamination exists or existed in a portion of the site. The deed recordation will reference this CAP and other environmental documents that contain the rationale for the restrictions.

In the event that the ownership of the property was transferred, the government's disposal agency would ensure that the transfer documents for real property reflect the groundwater use controls. The legal office of the government and its telephone number would be included as a point of contact in the purchase agreement and deed in case a problem arises with a use control, additional contamination is found, or the transferee wishes to revise or terminate a groundwater use control. All applicable and appropriate state land use control management systems in effect at the time of transfer would also be implemented. Additional land use control mechanisms related to property transfer (notices, media use restrictions, self-certification) would be evaluated and implemented as necessary and appropriate.

4.2.2.2 Evaluation of Institutional Controls

Institutional controls applied through ETA accelerates the return of idled or underused property to productive use. Re-utilization of existing infrastructure also prevents development of outlying greenfields. In addition to creating jobs and increasing tax revenues, there are several benefits to state regulatory agencies and local communities. This is especially true when the buyer completes the cleanup. For example, state oversight of the cleanup is simpler and less costly when a non-federal owner is conducting the cleanup. Sovereign immunity and state authority issues may be eliminated. Also, state enforcement and the application of institutional controls are generally less problematic with a single private entity. Combining the above factors with the purchaser's added incentive for results accelerates the environmental cleanup process. Environmental insurance can help assure lenders, regulators, owners, and local communities that adequate funds will be available.

Institutional controls provide an effective means of protecting human health. This approach takes no active steps to reduce contamination at the site but, when properly implemented, provides an effective means of protecting human health.

Applicability

Institutional controls can be applied to the site in order to provide long term protection of human health.

Limitations

Institutional controls do not provide documentation of long-term contaminant reduction.

Feasibility

Institutional controls are easily implemented at the site. Institutional controls can be applied to the site by registering the restrictions with the Jackson County Records Department. ETA has been proven feasible and successful at many other sites. As ETA benefits both the landowner and the local community, the process is easily initiated and completed.

Because institutional controls provide long term protection for human health through deed recordation and groundwater use restrictions, institutional controls will be retained for further consideration.

4.2.3 Groundwater Monitoring

A groundwater monitoring program would document both the effectiveness of any chosen remediation process in reducing contaminant concentrations and the level of exposure to potential receptors from those contaminants.

Applicability

Groundwater monitoring is applicable to most remediation sites where contamination exists. Long term monitoring would document contaminant reduction and demonstrate that receptors will not be exposed to increasing groundwater contamination. Groundwater monitoring is considered applicable to groundwater contamination at the site.

Limitations

There are no limitations for groundwater monitoring at the site.

Feasibility

Groundwater monitoring is considered feasible to implement and involves only periodic groundwater sampling and project oversight with respect to reporting of groundwater trends, maintaining institutional controls until remedial standards area achieved, and public education. Groundwater monitoring would be relatively easy to implement given that groundwater monitoring wells exist downgradient of the source area. Additional monitoring wells may be required to adequately monitor the contaminant concentrations and potential exposure concentrations.

Groundwater monitoring will be retained for further consideration.

4.2.4 Hydraulic Containment

Containment measures are often performed to prevent, or significantly reduce, the migration and concentration of contaminants in groundwater. In general, containment is performed when the migration of contaminants represents a threat to human health and the environment, and the entire contaminant plume will need to be contained. Containment can be accomplished by utilizing extraction wells to create a hydraulic barrier, or by the installation of interception trenches or slurry walls to stop migration of contaminants. Extraction is generally performed by installing extraction wells within a plume to remove contaminated groundwater. After groundwater is extracted from the subsurface, treatment is usually required.

4.2.4.1 Groundwater Extraction

Groundwater extraction involves the installation of a pump within a well to remove contaminated groundwater. The extracted groundwater would then require treatment prior to discharge and/or disposal. Groundwater extraction is a principle component of pump-and-treat processes, which are commonly used at contaminated sites.

The purpose of groundwater extraction is to remove contaminants from the groundwater, thereby reducing contaminant concentrations and preventing migration of contaminants beyond the well. Well design is dependent on the physical site characteristics of the groundwater and type(s) of contaminants.

The effectiveness of a groundwater extraction system is determined by performing groundwater monitoring. Groundwater monitoring helps to assess the overall reduction of contaminant levels and ultimately assist in determining the duration of groundwater extraction activities. Piezometers may be installed to allow the operator to make iterative adjustments to the pumping rates in response to changes in subsurface conditions or the treatment processes.

<u>Applicability</u>

Groundwater extraction is considered an applicable technology for corrective measures at the site.

Limitations

The following factors may limit the applicability and effectiveness of groundwater extraction as part of the remedial process:

- Site geologic conditions present a significant limitation to effectively implementing groundwater extraction. Previous remediation activities performed on site involved source removal by excavation (up to 30 feet below ground surface). Soils were primary moist to dry silty clays. In the event that groundwater at depth were in contact with residual source materials in these clays, groundwater extraction would be limited due to low hydraulic conductivity
- System designs may fail to contain the contaminant as predicted, allowing the plume to migrate, or pumping equipment failure occurs rendering the technological approach unsatisfactory
- Residual saturation of the contaminant in the soil pores cannot be removed by groundwater extraction. Contaminants tend to be sorbed in the soil matrix
- Biofouling of the extraction wells and associated treatment train is a common problem that can severely affect system performance.

Feasibility

Groundwater extraction is a component of many pump and treat processes, and is one of the most commonly used groundwater remediation technologies at contaminated sites. Whereas groundwater extraction does not remediate the contaminants in the groundwater, it does provide the means for pumping the groundwater to the surface for treatment. However, groundwater extraction is not considered feasible due to subsurface geologic conditions at the site.

Groundwater extraction will not be retained for further consideration.

4.2.5 Groundwater Treatment

Groundwater treatment can be performed following extraction (ex-situ) or by directly remediating the groundwater in place (in-situ). Groundwater that is extracted usually requires treatment prior to disposal. Ex-situ treatment generally requires shorter time periods but requires pumping of groundwater, leading to increased costs. In-situ treatment allows groundwater to be treated without being brought to the surface, resulting in significant cost savings. In-situ treatment requires longer time periods and there is less certainty about the uniformity of treatment because of variability in subsurface geology.

4.2.5.1 Physical Groundwater Treatment

The physical groundwater treatment technologies evaluated in this section include:

- Air Sparging
- Hot Water or Steam Flush/Strip
- Liquid Phase Carbon Adsorption

4.2.5.1.1 Air Sparging

Air sparging is an in-situ technology in which air is injected through a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column within the groundwater, creating an underground stripping mechanism that removes VOCs in the groundwater by volatilization. This injected air helps to flush (bubble) the contaminants up into the unsaturated zone where a soil vapor extraction (SVE) system is usually implemented in conjunction with air sparging to remove the vapor phase contamination. This technology is designed to operate at high flow rates to maintain increased contact between groundwater and soil, and to strip more groundwater by sparging. Oxygen added to contaminated groundwater and vadose zone soils can also enhance biodegradation of contaminants below and above the water table. Air sparging has a medium to long duration, and is more effective in areas with high concentrations of VOCs.

Applicability

The target contaminant groups for air sparging are VOCs. Target contaminants at the site for groundwater are gasoline constituents which are VOCs. Air sparging is considered applicable to site.

Limitations

Factors that may limit the applicability and effectiveness of the process include:

- Airflow through the saturated zone may not be uniform, which implies that there can be uncontrolled movement of potentially dangerous vapors
- Depth of contaminants and specific site geology may interfere with the effectiveness of the technology
- Soil heterogeneity may cause some zones to be relatively unaffected
- If air sparging is performed in areas where no contaminated soils are evident, then the stripping of the groundwater could result in contaminating the soil unless intensive SVE is performed.

Feasibility

Air sparging is not considered feasible at the site primarily because air sparge may require additional treatment technologies and would be adversity impacted by low permeability soils.

Air sparging will not be retained for further consideration.

4.2.5.1.2 Hot Water or Steam Flush/Strip

Hot water or steam flush/strip remediation techniques involve the forcing of hot water or steam into an aquifer through injection wells to vaporize volatile and semi-volatile contaminants. Vaporized components rise to the unsaturated zone where they are removed by SVE and then treated. Hot water or steam flushing/stripping is a pilot-scale technology. Biological treatment follows the displacement of vaporized volatiles and semi-volatiles. Treatment continues until groundwater contaminant concentrations satisfy regulatory requirements. The process has been successful in removing large portions of oily waste accumulations and retarding downward and lateral migration of organic contaminants. The process is applicable to shallow and deep contaminated areas, and readily available mobile equipment can be used.

Applicability

The target contaminant groups for hot water or steam flushing/stripping are SVOCs and fuels. This technology is applicable to gasoline constituents that are present at this site.

Limitations

Factors that may limit the applicability and effectiveness of the process are similar to those for air sparging. Site specific soil heterogeneity and depth of contaminants may interfere with uniform delivery of the hot water/steam to the subsurface, which could significantly impact process effectiveness.

Feasibility

This technology is not considered feasible at this site due to site geology. Contaminants are present in clay soils that are not conducive to vertical flow of steam or water.

Hot water or steam flush/strip technologies will not be retained for further consideration.

4.2.5.1.3 Liquid Phase Carbon Adsorption

Liquid phase carbon adsorption (LPCA) is a full-scale ex-situ technology in which groundwater is extracted and pumped through one or more vessels containing activated carbon to which dissolved organic contaminants adsorb. When the concentration of contaminants in the effluent from the bed exceeds a certain level, the carbon can be regenerated in place, removed and regenerated at an off-site facility, or removed and disposed.

Pretreatment for removal of suspended solids from influent streams is an important design consideration. Suspended solids in a liquid stream may accumulate in the column, causing an increase in pressure drop. When the pressure drop becomes too high, the accumulated solids must be removed. The solids removal process necessitates adsorber downtime and may result in carbon loss and disruption of the mass transfer zone.

Applicability

The target contaminant groups for carbon adsorption are hydrocarbons and SVOCs. LPCA is effective for removing contaminants at low concentrations from water at nearly any flow rate and for removing higher concentrations of contaminants from water at low flow rates [typically 2 to 4 liters per minute or 0.5 to 1 gallons per minute (gpm)]. Although LPCA is effective as a primary treatment process, it is particularly effective as a secondary treatment (polishing) process in conjunction with other remedial technologies to attain regulatory compliance. Because LPCA requires groundwater extraction, and groundwater extraction is not feasible at the site, LPCA is not applicable to the site.

Limitations

The following factors may limit the applicability and effectiveness of the process:

- LPCA requires groundwater extraction which is not considered applicable to this site
- Streams with high suspended solids [> 50 milligrams per liter (mg/L)] and oil and grease (> 10 mg/L) may cause fouling of the carbon and may require frequent treatment. In such cases, pretreatment is generally required
- Costs are high if used as the primary treatment on waste streams with high contaminant concentration levels
- Type, pore size, and quality of the carbon, as well as the operating temperature, will impact process performance
- Water-soluble compounds and small molecules are not adsorbed well
- All spent carbon eventually needs to be properly disposed.

Feasibility

Although this process is effective as a primary treatment process, it would be more effective for use as a secondary treatment process to polish treated effluent prior to discharge.

LPCA will not be retained for further consideration due to limitations in its ability to remediate groundwater contamination as a stand-alone technology.

4.2.5.2 Biological Groundwater Treatment

4.2.5.2.1 Enhanced In-situ Bioremediation

In-situ bioremediation relies on indigenous microorganisms to break down dissolved phase contaminants in the groundwater. Enhanced in-situ bioremediation involves using injection wells or trenches to introduce oxygen and/or nutrients into the subsurface environment to promote the growth of naturally occurring microorganisms and accelerate the breakdown of contaminants.

Applicability

In-situ bioremediation is applicable for the remediation of groundwater contaminated with gasoline constituents. In-situ bioremediation is a proven technology where properly implemented. Because the groundwater contamination plume at the site is small, groundwater extraction or circulation would not be required to effectively implement in-situ bioremediation. As a result enhanced in-situ bioremediation is considered applicable to the site.

Limitations

Factors that may limit the applicability of enhanced in-situ bioremediation are presented below:

- Where the subsurface is heterogeneous, it is difficult to enhance bioremediation by delivering oxygen and the nutrient solution throughout every portion of the contaminated zone. Higher permeability zones will be cleaned up much faster because groundwater flow rates are greater
- Biological treatment is usually implemented above a low permeability layer and with groundwater monitoring wells downgradient.

Feasibility

Enhanced in-situ bioremediation is considered applicable to the site and the type of contamination present. Due to the small plume size, few injection points would be required. The MO DNR allows the injection of compounds into the subsurface for remediation of groundwater through an injection control program. Further information about the injection control permit process is included in Subsection 7.2. Enhanced in-situ bioremediation is considered feasible for this site. Additionally, existing groundwater monitoring wells can be used to monitor contaminant degradation.

Enhanced in-situ bioremediation will be retained for further evaluation.

4.3 Soil Response Actions and Associated Remedial Technologies

4.3.1 No Action

The no action option is based on the lack of implementation of any corrective measures alternatives at the site. This option does not take steps to reduce contamination and does not provide protection of human health and the environment.

Applicability

No active steps would be taken to implement or document contaminant reduction or protection to human health and the environment. However, this technology would be applicable to this CAP so that a comparison can be made between taking no action at the site and implementing various alternatives.

Limitations

No action does not document the reduction of contamination and does not provide long-term protection of human health and the environment.

Feasibility

Because no steps or processes are required for no action it is feasible to implement at this site.

No action will be retained for further consideration a basis for comparison with other technologies/alternatives.

4.3.2 Institutional Controls

Institutional controls are those actions that will control land use and site access through public agencies or records. Institutional controls do not have a direct bearing on site restoration (i.e., not an active form of remediation) but reduce the potential for human exposure. Institutional controls for the purpose of this CAP will implemented through requirements of ETA, CERCLA Section 120(h)(3) (transfer of federal property by deed before all necessary remedial action has been taken).

ETA allows for the deferral of the required CERCLA deed covenant that states that "all remedial action necessary to protect human health and the environment has been completed prior to property transfer." The federal landholding agency assembles a CDR package to formally request deferral of the CERCLA covenant until completion of cleanup. The governor of the state and, when the property is a NPL site, the US EPA Administrator, must determine that the property is suitable for early transfer. In this case, the site is not an NPL site and only the Governor of Missouri would be involved. Suitability for early transfer is evaluated on the following criteria:

- The intended reuse is consistent with the protection of human health and the environment
- The deed or other agreement proposed to govern the transfer contains assurances that provide:
  - any necessary use restrictions will ensure the protection of human health and the environment by restricting groundwater use at the site
  - any necessary use restrictions will ensure that required cleanup actions will not be disrupted
  - that all necessary response action will be taken and identify the schedule for investigation and completion of all necessary response action as approved by the appropriate regulatory agency
  - that the federal agency responsible for the property will submit a budget request to the OMB that adequately addresses schedules for investigation and completion of all necessary response action subject to Congressional authorizations and appropriations.
- The deferral of the covenant will not substantially delay any necessary response action on the property
- The public was given notice and allowed at least 30 days to review and comment on the suitability of the property for early transfer.

4.3.2.1 Land Use Restrictions

Placing land use restrictions on the property would involve the documentation of the restrictions with the Jackson County Records Department. The Jackson County Records Department would restrict digging or excavation below specified depths in or near the existing soil contamination. This would be important for protection of human health for reasons such as preventing the direct exposure to contaminated soil on the property through digging or excavation activities.

Deed recordation other than the transfer agreement specified within ETA would also be used to establish land use restrictions. The deed recordation or transfer agreement would, in perpetuity, notify any potential purchaser of the property that soil contamination exists or existed in a portion of the site. The deed recordation will reference this CAP and other environmental documents that contain the rationale for the restrictions.

In the event that the ownership of the property was transferred, the government's disposal agency would ensure that the transfer documents for real property reflect the land use controls. The legal office of the government and its telephone number would be included as a point of contact in the purchase agreement and deed in case a problem arises with a use control, additional contamination is found, or the transferee wishes to revise or terminate a land use control. All applicable and appropriate state land use control management systems in effect at the time of transfer would also be implemented. Additional land use control mechanisms related to property transfer (notices, media use restrictions, self-certification) would be evaluated and implemented as necessary and appropriate.

4.3.2.2 Evaluation of Institutional Controls

Institutional controls provide an effective means of protecting human health. This approach takes no active steps to reduce contamination at the site but, when properly implemented, provides an effective means of protecting human health.

<u>Applicability</u>

Institutional controls can be applied to the site in order to provide long term protection of human health.

<u>Limitations</u>

Institutional controls do not provide documentation of long-term contaminant reduction.

Feasibility

Institutional controls are easily implemented at the site. Institutional controls can be applied to the site by registering the restrictions with the Jackson County Records Department. ETA has been proven feasible and successful at many other sites. As ETA benefits both the landowner and the local community, the process is easily initiated and completed.

Because institutional controls provide long term protection for human health through deed recordation and land use restrictions, institutional controls will be retained for further consideration.

4.3.3 Excavation

This technology includes excavation and removal of contaminated soils. Soils would be excavated, stockpiled, sampled, loaded into trucks and transported off-site for treatment and/or disposal. Some pretreatment of the contaminated media may be required.

Applicability

Excavation and off-site disposal is applicable to the complete range of contaminant groups with no particular target group. Excavation is considered applicable to the type of soil contamination present at this site.

Limitations

Limitations associated with excavation and off-site disposal are presented below.

- Generation of fugitive emissions may be a problem during excavation
- The distance from the contaminated site to the disposal facility influences cost
- Depth of the contaminated media and the localization of the contamination must be considered.

Feasibility

The excavation and disposal of contaminated soils near Building 4 is feasible due to the clay soils. At the site, soil contamination is located at depths of 7 to 16 feet bgs and the surface area to be excavated is not extensive. Additionally, the site geology is conducive to this type of remediation. Large scale excavations in unsaturated soils up to 35 feet bgs have been performed on the site near Building 4.

Excavation and off-site disposal will be retained for further consideration.

4.3.4 In-situ Treatment

In-situ treatment allows soil to be treated without being excavated and transported, resulting in significant cost savings. In-situ treatment technologies generally require that long time periods and variability in soil characteristics can make uniform degradation of contaminants difficult. Physical and biological in-situ treatment technologies are discussed in the following sections.

4.3.4.1 Physical

In-situ physical treatment of soil uses the physical properties of the contaminants or the contaminated medium to destroy, separate, or contain the contamination. Physical treatment is typically cost effective and can be completed in short time periods (in comparison with biological treatment). Equipment is readily available and is not engineering or energy-intensive. Treatment residuals from separation techniques will require treatment or disposal, which will add to the total project costs and may require permits.

4.3.4.1.1 Thermally-Enhanced Soil Vapor Extraction

Thermally-enhanced SVE is a technology that uses electrical resistance heating, electromagnetic/radio frequency heating, or hot air/steam injection to increase the volatilization rate of VOCs to facilitate extraction. The heating apparatus would be placed in various locations along with extraction and injection points. The extraction and injection points are similar to groundwater extraction wells, except that they are typically screened above the groundwater surface. The extracted vapor may be treated and discharged to the atmosphere or re-injected into the soil to provide oxygen for further biodegradation of contaminants. If injection points were used, an underground injection control permit would be required.

Thermally-enhanced SVE is normally a short-to-medium term technology. The process is similar to standard SVE, but requires heat resistant extraction wells and one or more of the following enhancements:

- *Electrical Resistance Heating* uses an electrical current to heat less permeable soils such as clays and fine-grained sediments so that water and contaminants trapped in these relatively conductive regions are vaporized and ready for vacuum extraction. Electrodes are placed directly into the less permeable soil matrix and activated so that electrical current passes through the soil, creating a resistance, which then heats the soil. The heat dries out the soil causing fractures
- *Radio Frequency Heating (RFH)* is an in-situ process that uses electromagnetic energy to heat soils and enhances soil vapor extraction. The RFH technique heats a discrete volume of soil using rows of vertical electrodes embedded in soil. The technique can heat soils to over 300 degrees Celsius (°C)
- *Hot Air or Steam Injection* is implemented below the contaminated zone to heat up contaminated soil. The heating enhances the release of contaminants from the soil matrix.

Applicability

Thermally-enhanced SVE is effective in remediating heavy fuel oils but not as effective in remediating VOC contamination. High moisture content, clays, and fine-grained sediments are limitations of standard SVE that thermal enhancement may help overcome. Heating, especially radio frequency heating and electrical resistance heating, can improve airflow in high moisture content but is limited in clays and fine-grained sediments. After application of this process, subsurface conditions are excellent for biodegradation of residual contaminants.

As with SVE, remediation using thermally-enhanced SVE systems are highly dependent upon specific soil and chemical properties of the contaminated media. A typical site consisting of 20,000 tons of contaminated media would require approximately 12 months to remediate using this technology.

Limitations

Limitations associated with thermally-enhanced SVE are presented below.

- Soil contamination at the site is present in clay soils. Although thermally-enhanced SVE may help overcome limitations presented by clay soils and effects on SVE, the degree to which thermal application would improve performance is not known.
- Off-gas treatment may be required
- Residual liquids may require treatment
- Thermally-enhanced SVE is not effective in the saturated zone
- Site specific soil heterogeneity may interfere with the uniform delivery of heat to the subsurface that could significantly impact process effectiveness.

Feasibility

The thermally-enhanced SVE process has been successful in removing large portions of oily waste accumulations and retarding downward and lateral migration of organic contaminants. The process is applicable to shallow and deep contaminated areas, and readily available mobile equipment can be used. However, the performance of this technology would be limited due to clays present at this site and, for the purpose of this CAP, is considered not feasible.

Thermally-enhanced SVE will not be retained for further consideration.

4.3.4.2 Biological

In-situ bioremediation techniques are destruction techniques directed toward stimulating the microorganisms to grow and use the contaminants as a food and energy source by creating a favorable environment for the microorganisms. Biological processes are typically implemented at low cost. Contaminants can be destroyed and often little to no residual treatment is required.

4.3.4.2.1 Bioventing

Bioventing is an in-situ process of moving air through contaminated soils to increase soil oxygen concentrations and stimulate the biodegradation of contaminants (US EPA, 1993a). Bioventing is similar in implementation and equipment to air sparge/SVE. The difference is in the flow rates of air. In soil venting, the vacuum is set at a low enough pressure so that air is circulated within the soil column to keep the system aerobic, the flow rate is kept as low as possible to conserve moisture. With SVE, as much air as is physically possible is withdrawn from the soil column.

Applicability

Bioventing is effective in remediating soils contaminated with VOCs and fuels. Bioventing is applicable to soils with high permeability. The on-site soils are clay which have a low permeability. The circulation of air would not be very efficient and hard to control.

Limitations

MO DNR considers bioventing a "Passive Corrective Action." According to MO DNR the site must meet all of the following for conditions for "Passive Corrective Action". The four conditions are:

- There is no potential for contaminant migration
- There is no physical access to contaminated areas for cleanup equipment or personnel
- There is no significant risk of harm to public health, safety, and the environment as indicated by technically based risk and exposure assessment
- There is convincing evidence that there are no active remediation technologies that will work at the site.

These limitations can not be met at this site. Additionally, bioventing would require an underground injection control permit.

Feasibility

Due to the presence of soil contamination in clay soils at the site, the distribution of air would be limited. Additionally, due to restrictions with respect to MO DNR guidance, bioventing is not considered feasible.

Bioventing will not be retained for further consideration.

5.0 DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVES

5.1 Evaluation of Retained Technologies

Section 4.0 presented remediation technologies for specific groundwater and soil response actions. Based on the site contaminants, site conditions, and inferred limitations associated with various technologies presented in Section 4.0, several of the remedial technologies were eliminated as viable alternatives.

The technologies retained for further evaluation for groundwater and soil response actions are provided in the following tables:

Retained Groundwater Technologies

Response Action	Retained Action
No Action	None (retained for comparative purposes)
Institutional Controls	Deed Assurances, ETA
Groundwater Treatment	Enhanced In-situ Bioremediation
Groundwater Monitoring	Groundwater Monitoring

Retained Soil Technologies

Response Action	Retained Action
No Action	None (retained for comparative purposes)
Institutional Controls	Deed Assurances, ETA
Excavation	Excavation and Off-Site Disposal

5.2 Formulation of Corrective Measures Alternatives

Corrective Measure Alternatives (CMA) are formulated to address the environmental issues and contaminant pathways associated with the site. The alternatives were developed based on the following considerations:

- The CMAs were developed to address the corrective measure objectives established for the site in Section 3.0
- The CMAs were formulated using the technologies retained from the screening process discussed in Section 4.0
- Response actions and technologies that are complementary and/or interrelated were combined to form CMAs
- A no action alternative is retained for comparative purposes
- The CMAs are formulated to facilitate the transfer of property through ETA.

5.3 Corrective Measure Alternatives

The technologies retained from Section 4.0 have been combined into CMAs based on the considerations presented in Subsection 5.2. The CMAs are presented for groundwater and soil at the site.

5.3.1 Groundwater CMAs

The following Groundwater CMAs have been developed:

- Alternative No. 1 – No Action
- Alternative No. 2 – Enhanced In-situ Bioremediation, Groundwater Monitoring, and Institutional Controls

5.3.2 Soil CMAs

The following Soil CMAs have been developed:

- Alternative No. 3 – No Action
- Alternative No. 4 – Excavation, Off-Site Disposal, and Institutional Controls

5.3.3 CMA Evaluation

Section 6.0 will evaluate each alternative with respect to effectiveness, implementability, and cost.

6.0 Detailed Evaluation of Corrective Measures

This section presents a detailed analysis of CMAs related to groundwater and soils at the Building 4 site. Each CMA will be evaluated with respect to its effectiveness, implementability, and cost. Effectiveness evaluates the ability of the alternative to meet the corrective measure objectives and evaluate if the alternative has a proven history and reliability. Implementability evaluates the ability of the alternative to meet technical aspects of construction and operation and maintenance (O&M) for the project. Cost provides capital and O&M cost estimates for each alternative.

The CMAs for groundwater are presented below:

- Alternative No. 1 – No Action
- Alternative No. 2 – Enhanced In-situ Bioremediation, Groundwater Monitoring, and Institutional Controls.

The CMAs for soil are:

- Alternative No. 3 – No Action
- Alternative No. 4 – Excavation, Off-Site Disposal, and Institutional Controls.

6.1 Evaluation Criteria

The evaluation criteria presented in this section are effectiveness, implementability, and cost. Each CMA will be evaluated according to these criteria. The CMA that is evaluated as the most beneficial alternative with respect to effectiveness, implementability, and cost will be selected as the recommended corrective measure for the site. Each evaluation criterion is described below.

6.1.1 Effectiveness

This criterion evaluates the extent to which a remedial action meets the corrective measure objectives described in Section 3.0 with an emphasis on reducing the overall risk to human health and the environment. It also considers the degree to which the action provides sufficient long-term controls and reliability to prevent exposures that exceed levels protective of human and environmental receptors. Factors considered include performance and reliability characteristics, the ability to reduce contaminant concentration, and a proven track record.

6.1.2 Implementability

This criterion evaluates the technical and administrative factors affecting implementation of a remedial action and considers the availability of services and materials required during implementation. Technical factors assessed include ease and reliability of initiating construction and O&M, prospects for implementing any additional future actions, and adequacy of monitoring systems to detect failures. Uncertainties associated with construction, operation, and performance monitoring are also considered.

Service and material considerations include equipment and operator availability and applicability or development requirements for prospective technologies. The availability of services and materials is addressed by considering the material components of the proposed technologies and the locations and quantities of those materials. Administrative factors include ease of obtaining permits, enforcing deed restrictions, or maintaining long-term control of the site.

6.1.3 Cost

Relative costs are included for each remedial action technology to facilitate evaluation and comparison among alternatives. Costs presented in this section included a breakdown of estimated implementation (capital) costs as well as a comparison of O&M costs for the applicable technologies.

6.2 Evaluation of Alternatives for Groundwater

6.2.1 Alternative No.1 – No Action

6.2.1.1 Description of Alternative No. 1

The No Action alternative provides a basis for comparing existing site conditions with those resulting from implementation of the other proposed alternatives.

Under Alternative No. 1, reduction in contaminant concentrations will be achieved via unmonitored natural attenuation. Existing groundwater migration pathways remain as-is since no additional remedial activities are implemented at the site. Concentrations of contaminants above cleanup levels will remain in the groundwater near Building 4 for decades.

6.2.1.2 Evaluation of Alternative No. 1 - No Action

Effectiveness

Alternative No. 1 results in no additional risk reduction at the site. The no action alternative would provide risk reduction through ongoing natural attenuation processes in soil and groundwater. However, the risk reduction would not be monitored or documented. This alternative does not meet the corrective action objective and is not protective of human health or the environment.

Implementability

This alternative is technically and administratively implementable, as no engineering or administrative procedures are required.

Cost

No costs are associated with the Alternative No. 1 since no actions are being implemented at the site.

6.2.2 Alternative No. 2 - Enhanced In-situ Bioremediation, Groundwater Monitoring, and Institutional Controls

6.2.2.1 Description of Alternative No. 2

In-situ bioremediation relies on indigenous microorganisms to break down dissolved phase contaminants in the groundwater. Enhanced in-situ bioremediation would involve actively introducing oxygen and/or nutrients into the subsurface environment to promote the growth of naturally occurring microorganisms and accelerate the breakdown of contaminants.

A groundwater monitoring program would be implemented that would document both the effectiveness of the remediation process in reducing contaminant concentrations and confirm that the contamination is not moving downgradient.

Institutional controls are those actions that will control groundwater use and site access through public agencies or records. In order to expedite the remediation of the site, institutional controls will be designed to facilitate the transfer of property through ETA. Institutional controls are those actions that will control groundwater use and site access through public agencies or records. Institutional controls do not have a direct bearing on site restoration (i.e., not an active form of remediation) but reduce the potential for human exposure. Institutional controls for the purpose of this CAP will implemented through requirements of ETA, CERCLA Section 120(h)(3) (transfer of federal property by deed before all necessary remedial action has been taken). All remedial actions necessary to protect human health and the environment presented in this CAP will be implemented through the ETA and/or transfer agreements.

A major facet involved in implementing institutional controls to achieve ETA is the designation of property use. The deed restrictions will disallow the use of the property for activities that would allow contact with groundwater. The property will be transferred solely for permitted uses.

Effectiveness

Enhanced in-situ bioremediation is effective in the treatment of constituents of VOCs. Therefore, this technology would be effective in reducing and/or capturing the contaminants for treatment, and would meet the remedial action objective for this area. Groundwater monitoring would be effective in documenting the reduction of groundwater contamination. Institutional controls are not an effective means of reducing or controlling existing contamination. However, institutional controls would be effective in protecting human health by limiting access to groundwater and facilitating groundwater remediation through the ETA process.

Institutional controls implemented through ETA such as groundwater use restrictions and deed recordation will be effective in protecting human health and the environment. Additionally, ETA provides a method for effective and timely remediation. ETA presents the following advantages with respect to timely remediation of the site:

- Allows transfer of contaminated property to the purchaser before all necessary cleanup actions have taken place. If ETA could not be obtained for this site, the corrective measure objective for groundwater would not be met for many years
- Accelerates cleanup via privatization. The purchaser would have the incentive to initiate remediation of the site as soon as possible and to use contractors who would perform the remediation in a timely and efficient manner. Additionally, cleanup can be integrated with redevelopment resulting in improved cost effectiveness
- Generates tax revenues and employment opportunities early from quicker development and reuse
- Ensures that required investigations, response actions, and oversight activities are not disrupted.

Implementability

Enhanced in-situ bioremediation is implementable. The system components are readily available and the design, construction, and start-up phases are well established and easily implemented. Groundwater monitoring is easily implemented by utilizing the existing monitoring wells on site. Additional monitoring wells can be installed for monitoring purposes. Institutional controls are easily implemented through the ETA process, which has been completed successfully at a number of federal properties throughout the United States.

Cost

Alternative No. 2 implementation costs are moderate as compared to typical site cleanups. Capital costs for this alternative, including installation of the bioremediation and groundwater monitoring system would be approximately $328,300. The O&M costs would be approximately $31,600 yearly and $136,950 over five years (adjusted for present worth cost). Treatment costs are dependent on the length of time needed for contaminant reduction to cleanup levels and the number of applications of oxygen/nutrients needed to achieve the cleanup levels. The approximate costs for implementation of Alternative No. 2 are presented in Table 3. The detailed cost breakdown for this alternative is presented in Appendix D.

6.3 Evaluation of Alternatives for Soil

6.3.1 Alternative No. 3 - No Action

6.3.1.1 Description of Alternative No. 3

The no action alternative provides a basis for comparing existing site conditions with those resulting from implementation of the other proposed alternatives. Alternative No. 3 does not involve corrective measures in reference to the soils at the Building 4 site. The soils will remain in-place and contaminant reduction will only occur through unmonitored natural attenuation.

6.3.1.2 Evaluation of Alternative No. 3

<u>Effectiveness</u>

Alternative No. 3 can be considered effective in reducing contaminant levels due to biodegradation over time. Short and long-term exposures to contaminated soils are not addressed as part of the no action alternative.

<u>Implementability</u>

This alternative is technically and administratively implementable since no engineering or administrative procedures are required.

<u>Cost</u>

No costs are associated with Alternative No. 3, since no actions are being implemented at the site.

6.3.2 Alternative No. 4 – Excavation, Off-Site Disposal, and Institutional Controls

6.3.2.1 Description of Alternative No. 4

This technology includes excavation and removal of contaminated soils. Soils would be excavated, stockpiled, sampled, loaded into trucks, and transported off-site for disposal. After excavation, the excavated materials would be replaced with clean backfill. Institutional controls would be put in place to restrict land use and site access during and following excavation and to facilitate ETA. In order to expedite the remediation of the site, institutional controls will be designed to facilitate the transfer of property through ETA. Institutional controls are those actions that will control land use and site access through public agencies or records. Institutional controls do not have a direct bearing on site restoration (i.e., not an active form of remediation) but reduce the potential for human exposure. Institutional controls for the purpose of this CAP will implemented through requirements of ETA, CERCLA Section 120(h)(3) (transfer of federal property by deed before all necessary remedial action has been taken). All remedial actions necessary to protect human health and the environment presented in this CAP will be implemented through the ETA and/or transfer agreements.

A major facet involved in implementing institutional controls to achieve ETA is the designation of property use. The deed restrictions will disallow the use of the property for the purpose of residences, schools, parks, recreation, care of minors, food warehousing, agriculture, nurseries, or any other use involving contact with or use of soil. The property will be transferred solely for permitted uses.

6.3.2.2 Evaluation of Alternative 4

<u>Effectiveness</u>

Excavation is applicable to the complete range of contaminant groups. Excavation is considered an effective means of removing soil contamination by providing long-term contaminant concentration reduction at the source. Institutional controls are not an effective means of reducing or controlling existing contamination. However, institutional controls would be effective in protecting human health by limiting access to subsurface soil and facilitating soil remediation through the ETA process. Remedial action objectives would be met through excavation of contaminated soils and implementation of institutional controls.

Implementability

Equipment for this alternative is readily available and implementation could be relatively quick and easy. Excavation activities to depths of approximately 35 feet have been successfully completed at the Hardesty Federal Center.

Cost

The cost of excavating the soils will be moderate to high depending on the volume of soils to be removed. Capital costs for this alternative would be approximately $422,300. O&M costs would not be incurred as excavation of soils does not require further maintenance. The approximate costs for implementation of Alternative No. 4 are presented in Table 4. The detailed cost breakdown for this alternative is presented in Appendix D.

6.4 Comparison of Corrective Measures Alternatives

The following subsections provide a brief comparison of the CMAs.

6.4.1 Groundwater

The CMAs for groundwater are:

- Alternative No. 1 – No Action
- Alternative No. 2 – Enhanced In-situ Bioremediation, Groundwater Monitoring, and Institutional Controls.

Effectiveness

Alternative No. 1 is a no action alternative, which does not involve any remedial actions. It is not effective in meeting remedial action objective.

Alternative No. 2 is enhanced in-situ bioremediation, groundwater monitoring, and institutional controls. This is a proven technology for treating VOCs and is effective in meeting the remedial action objective.

Implementability

Alternative No.1 is easily implementable since no action will be taken.

Alternative No. 2 would involve the installation of several injection wells or trenches. Groundwater monitoring is easily implemented with the use of existing wells at the site. Institutional controls encompassed in the ETA process have proven to be implementable.

Cost

No costs are associated with Alternative No. 1.

The estimated total cost for implementation of Alternative No. 2 including capital investment and O&M is $465,200.

6.4.2 Soil

The CMAs for soil are:

- Alternative No. 3 – No Action
- Alternative No. 4 – Excavation, Off-Site Disposal, and Institutional Controls.

Effectiveness

Alternative No. 3 would not be effective since it does not address the corrective measure objective.

Alternative No. 4 would be effective by removing the contaminated soil and replacing it with clean soil. The excavation of the contaminated soils could be implemented in a short period of time and completed within 10 days. Institutional controls would not be effective in remediation of contaminated soils, but used as a supplement to control exposure during and following excavation activities and to facilitate the remediation process through ETA.

Costs

No costs are associated with Alternative No. 3.

The approximate capital costs for Alternative No. 4 would be $422,300. No O&M costs are projected for Alternative No. 4.

6.5 Recommended Remedial Action

6.5.1 Groundwater

Alternative No. 2 – Enhanced In-situ Bioremediation, Groundwater Monitoring, and Institutional Controls via ETA is the recommended CMA for groundwater treatment.

The primary advantages of this alternative are summarized below:

- Alternative No. 2 is a proven treatment process for gasoline constituents. The corrective measure objective for groundwater would be met using this alternative.
- Reduction of groundwater contamination would be documented by groundwater monitoring and implementation of institutional controls would facilitate site remediation through ETA.
- ETA will ensure timely remediation activities are performed at the site.
- The technologies have proven to be administratively feasible and technically implementable.

6.5.2 Soil

Alternative No. 4 – Excavation, Off-Site Disposal, and Institutional Controls via ETA is the recommended remedial action for the contaminated soil. The primary advantages of this alternative are summarized below:

- Excavation of the contaminated soils is the most effective option with respect to contaminant reduction and can be implemented over a short period of time. Excavation of soils would meet the corrective measure objective.
- Excavation has been used successfully to remove soil contaminants in other areas of the Hardesty Federal Center.
- This alternative would provide the maximum level of protection for human health because the source will be removed from the site.
- Institutional controls would prevent access to any remaining subsurface soil contamination and would facilitate the remediation process through ETA.

7.0 CONCEPTUAL DESIGN

The objective of this section is to provide a conceptual design of the proposed remedial actions presented in Section 6.0. The recommended remedial action for groundwater is Alternative No. 2 – Enhanced In-situ Bioremediation, Groundwater Monitoring, and Institutional Controls. The recommended remedial action for soil is Alternative No. 4 – Excavation, Off-site Disposal, and Institutional Controls.

7.1 Conceptual Design

The conceptual design of a recommended remedial action is a preliminary design of the cleanup alternative (15% design point). The purpose of the conceptual design is to describe the form and content of a corrective measure, provide key components or elements that would be required, and provide the procedures for implementing the corrective measures.

The conceptual design completes the process of the CAP for the unregulated USTs near Building 4 by detailing the recommended remedial actions for the site and providing the specific steps that would be required to meet the corrective measure objectives for the project. Steps for implementation of institutional controls and remediation of groundwater and soil are presented below.

7.1.1 Implementation of Institutional Controls

Upon approval of the CAP, institutional controls will be initiated at the site. The institutional controls will be implemented via ETA in accordance with CERCLA Section 120(h)(3). The GSA will prepare a CDR package for submittal to the Governor of Missouri. The CDR package will contain the following background information:

- Property description
- Nature and extent of contamination
- Analysis of the intended land use during the deferral period
- Summary of MO DNR-approved corrective actions for remediation of soil and groundwater at the site.

The CDR will contain a copy of the deed for the property and/or a copy of the property transfer agreement (PTA). The deed or PTA will contain the following:

- Notice: A copy of the notice to be included in the deed as required by CERCLA Section 120(h)(1) and (3) and in accordance with regulations set forth at 40 Code of Federal Regulations (CFR) Part 373
- Covenant: A copy of the covenant warranting that any additional remedial action found to be necessary after the date of transfer shall be conducted by the United States as required by CERCLA Section 120 (h)(3)(A)(ii)(II)
- Access: A copy of the clause which reserves to the government access to the property in any case in which an investigation, response, or corrective action is found to be necessary after the date of transfer as required by CERCLA Section 120(h)(3)(A)(iii)
- Response Action Assurances: A copy of the response action assurances that will be included in the deed or other agreement proposed to govern the transfer as required under CERCLA Section (h)(3)(C)(ii). As required by the statute, these assurances shall:
    - provide for any necessary restrictions on the use of the property to ensure the protection of human health and the environment
    - provide that there will be restrictions on the use necessary to ensure that required remedial investigations, response actions, and oversight activities will not be disrupted
    - provide that all necessary response actions will be taken and identify the schedule(s) for investigation(s) and completion of all necessary response action(s) as approved by the appropriate regulatory agency
    - provide that the GSA has or will obtain sufficient funding through either: (a) submission of a budget request (or budget requests in the event multi-year funding is needed) to the Director of the OMB that adequately addresses schedule for investigation and completion of all necessary response action, subject to congressional authorizations and appropriations; or (b) sufficient current appropriations to accomplish investigation(s) and completion(s) of all necessary response action(s). In addition to (a) or (b), the GSA may also have an agreement with the transferee to fund and/or accomplish all or part of the remediation.

The final CDR will include a response to comments document which contains the GSA's responses to the written comments received during the public comment period under Section 120 (h)(3)(C)(I)(III) and to the written comments received from the regulatory agencies on the draft CDR.

In the event that ownership of the property is transferred, a transferee may agree to conduct response actions on the property. However, the GSA remains responsible for ensuring that all necessary response actions including, as appropriate, investigations and requirements under an Interagency Agreement are done. When property is transferred prior to completion of the cleanup, the GSA should include in each deed provisions notifying the transferee of the requirement for, and status of, an Interagency Agreement or other enforceable environmental cleanup agreement or order, as appropriate.

The GSA will also notify the transferee that the State of Missouri and their agents, employees, and contractors, will have rights of access as necessary to implement response actions and oversight responsibilities at the facility.

In the event that the transferee has agreed to fund and conduct the cleanup or portions of the cleanup as a condition of the transfer, the GSA will provide to the State of Missouri documentation demonstrating that the transferee has or will become legally obligated to conduct the required response actions in accordance with the CAP. Should the transferee become unable or unwilling to complete the cleanup or order under its agreement with the GSA, the GSA will complete the cleanup.

If the transferee is expected to perform any response action (e.g., excavation of contaminated soil in an area where facilities are to be constructed), then the State of Missouri should receive assurance from the GSA that the transferee has:

- the technical capacity (in-house or through appropriate contract management) to perform anticipated investigations and response or corrective actions
- the financial capacity to execute environmental cleanup activity requirements that are known or can reasonably be anticipated, based on current information available.

The transferee should agree to conduct all necessary environmental response actions in accordance with CERCLA. In the case where the transferee does not perform cleanup in accordance with CERCLA or the terms of a cleanup agreement, then the United States may enter the property and perform any necessary response action.

7.1.1.1 Requesting Covenant Deferral

Before preparing a CDR, GSA will notify the Governor of Missouri of the intent to request a CERCLA Covenant Deferral and invite participation in the development and review of the draft CDR. This notice should allow sufficient time for EPA and State agencies to participate in the development and review and comment on a draft CDR.

As required by Section 120(h)(3)(C)(I)(III), the GSA will provide notice, by publication in a newspaper of general circulation in the vicinity of the property, of the proposed transfer. The notice should include:

- The identity of the property proposed for transfer, the proposed transferee and the intended use of the property
- A statement that the proposed transfer is pursuant to CERCLA 120(h)(3)(C) which allows the transfer of federal property before remedial action is completed when certain conditions are satisfied
- An assessment of whether the transfer is consistent with protection of human health and the environment will be made only after a comprehensive evaluation of the environmental condition of the property in consultation with the appropriate State agencies
- A summary of the decision-making process, e.g., that the property will not be transferred until the Governor of Missouri concurs that the transfer of the property for use as intended is consistent with protection of human health and the environment and that the federal agency has provided assurance that response actions will be taken
- The address and telephone number of the agency office which may be contacted for obtaining a copy of the draft CDR, site- specific information and the address of the location of the administrative record for the response program
- A statement that interested members of the public may comment on the suitability of the property (the draft CDR) for transfer and must submit such comments to the agency before a date not less than 30 days from the date of the publication of the notice.

After the public comment period has expired, the GSA may then submit the final CDR to the appropriate state representative. Property cannot be transferred by deed until the CERCLA Covenant is explicitly deferred by the State of Missouri.

7.1.1.2 Completion of Response Actions after Transfer

When all response actions necessary to protect human health and the environment have been taken [e.g., when there has been a demonstration to the State of Missouri that the approved remedy is "operating properly and successfully" pursuant to CERCLA Section 120(h)(3)(B) (regardless of whether the GSA or the transferee has taken the action)], the GSA shall execute and deliver to the transferee an appropriate document containing a warranty that all such response action has been taken. This warranty will satisfy the requirement of CERCLA Section 120(h)(3)(A)(ii)(I).

7.1.2 Remedial Action for Groundwater

The following subsections describe the purpose, description, and design criteria and basis for each element of the selected remedial action for groundwater.

7.1.2.1 Enhanced In-situ Bioremediation

7.1.2.1.1 Description

Bioremediation of groundwater at the site will be enhanced using Oxygen Releasing Compound (ORC®), a proprietary formulation of magnesium peroxide that releases oxygen slowly when hydrated. The ORC® is available in both a powder form that can be made into a slurry and exchangeable filter socks to be used in injection wells.

Prior to implementation of the corrective measures, additional data will be collected at the site. Based on MO DNR guidance, the parameters listed below will be collected and will be presented to MO DNR for final approval of the in-situ bioremediation corrective measure for groundwater. Prior to initiation of data collection, a sampling and analysis plan will be prepared and submitted to MO DNR. The following parameters have been collected during previous site investigations:

- Total extent of soil contamination to be treated
- Baseline soils contamination analytical data

- Soil type, texture, or grain size analysis
- Baseline soil properties
- Hydrogeologic constraints.

The following parameters will be collected upon approval of the sampling and analysis plan:

- Bioassay of types and populations of microbes
- Biofeasibility of bench scale studies
- Vertical infiltration rates
- Soil moisture and pH.

The parameters presented above will be compiled and submitted to MO DNR for final approval.

7.1.2.1.2 Design Criteria and Basis

For this application, the powder and slurry forms of ORC® will be used. Following excavation of contaminated soils, the ORC® slurry will be placed in the bottom of the excavation cavity prior to backfill with clean soils. This application will contact the groundwater at the bottom of the excavation in some areas and will permit enhanced bioremediation in the remaining soils. ORC® slurry will also be injected into the subsurface using direct push injection techniques.

Excavation Area Treatment

The first stage of enhanced bioremediation will be performed during soil excavation activities. A slurry containing 0.3% ORC® would be spread across the bottom of the excavation area where the water table is encountered. Where the water table is not encountered, the ORC® powder will be physically mixed with the soil in the upper 2 feet of the excavation floor.

Downgradient Plume Treatment

The second stage of enhanced bioremediation will entail application of ORC® to the subsurface by the use of direct push or augured holes into which a grout-like slurry of

ORC® is applied. ORC® is typically applied in a grid pattern or a barrier pattern over the intended area of treatment. The grid pattern approach attempts to amend the plume by injecting ORC® directly into the contaminated unit over the entire horizontal and vertical extent of the plume. The barrier approach is installed perpendicular to the groundwater flow direction at regular intervals (10 to 25 feet injection point spacing) throughout the length of the plume. The barrier approach is typically utilized for larger more widespread plumes.

Due to the relative immobility of the contaminant plume and the corrective measure objective of restoring groundwater to cleanup levels (rather than containment), the grid pattern will be used at this site. The proposed bioremediation system layout including projected locations of injection points is presented on Figure 10. The ORC® injection area would consist of fifty injection points configured in a grid pattern across the areal extent of the plume. The injection points will be spaced at 10 foot centers. The vertical injection points will be installed via geoprobe (direct push) techniques. A 40% ORC® slurry mixture will be injected into the groundwater at each injection point. Due to the elevated concentrations of BTEX and GRH at some sampling locations, another application may be required after six months to remediate groundwater in certain hot spots. An additional application of ORC® would help to counteract recharge of contamination from areas of clayey soil where gasoline constituents are sorbed in significant quantities.

7.1.2.2 Groundwater Monitoring

A groundwater monitoring program will be implemented to evaluate the groundwater contaminant plume and the effectiveness of the bioremediation system.

7.1.2.2.1 Description

Groundwater monitoring will be conducted on a semi-annual basis. The monitoring data will be utilized to optimize system performance and to ensure that remedial action objectives are being met. Concentration data for site contaminants will provide the critical basis for evaluating system performance.

7.1.2.2.2 Design Criteria and Basis

The existing monitoring wells that comprise the groundwater monitoring network are depicted on Figure 10. The five existing monitoring wells will be utilized to assess the effectiveness of the source area remediation. Three additional monitoring wells will be installed beyond the leading edge of the groundwater plume at the border of the property.

Groundwater samples will be analyzed using Iowa OA1 and OA2 Methods during monitoring efforts. The monitoring program will include water level measurements, concentration trend charts for key indicator constituents and plan view delineation of impacted groundwater. Groundwater monitoring will be conducted semi-annually for five years or until groundwater contaminant levels have been reduced below cleanup levels. The monitoring results and the performance of the remediation system will be evaluated on a quarterly basis within progress reports submitted to the MO DNR.

7.1.3 Remedial Action for Soil

The following subsections describe the purpose, description, and design criteria and basis for each element of the selected remedial action for soil.

7.1.3.1 Excavation and Off-Site Disposal

The purpose of the excavation and off-site disposal of contaminated soils is to remove soils contaminated above cleanup levels.

7.1.3.1.1 Description

The removal of soils contaminated with gasoline constituents is the first phase of the proposed CAP. Approximately 5,500 tons of contaminated soil will be removed. For purposes of estimating the volume of contaminated soil, the top 6 feet of soil is considered clean. Figure 9 shows the projected area of excavation. The specific calculations used to calculate the volume of excavated soil and tonnage of contaminated soil for disposal are presented in Table 5.

7.1.3.1.2 Design Criteria and Basis

The soil contamination is predominately located at 7 to 16 feet bgs. Excavation will continue horizontally until confirmation sampling indicates the soil contaminated above cleanup levels has been removed. Excavation will continue vertically until confirmation sampling indicates that soil contaminated above cleanup levels has been removed or groundwater is encountered. The projected area of excavation (indicated on Figure 9) is based on soil borings that indicated the presence of gasoline constituents above cleanup levels.

Soil excavation will be performed using a bulldozer, backhoe, two trackhoes, two operators, one laborer, one support person, and a Site Safety and Health Officer. As previously mentioned, CAPE has performed excavation activities at the Federal Center at the past. Although the soil has exhibited consistent tight clay composition that allows excavation without shoring or sloping requirements, some sloping of the excavation sidewalls will be performed for safety reasons. Due to the potential depth of excavation, operators will be required to operate equipment within the excavation cavity. Design of the work plan and the health and safety plan will anticipate the hazards involved in this activity and measures will be taken to sufficiently plan activities and protect workers during the project.

Soil samples will be collected from sidewalls of the excavation using the excavator bucket. The soil samples will be analyzed using a Photoionization Detector (PID). Soil samples will be placed in a ziplock bag and allowed to off-gas for 15 minutes. The tip of the PID probe will be inserted into the bag and the instrument reading will be noted in the field notebook along with location of the sample. The depth of the sample will also be noted in the field book. If field screening indicates a headspace reading of <10 ppm then the sample will be considered clean. A portion of the clean sample from each of the excavated area will be placed into a sample container and sent to the laboratory for analysis to confirm soils above cleanup levels have been removed.

Composite samples will be collected from soils that are stockpiled for disposal. These samples will be shipped off-site for analysis to characterize the soil for the off-site disposal facility. Once approval has been received from the off-site facility, the contaminated soil will be loaded in trucks and transported off-site. Soil that was determined to be clean by field analysis will be backfilled. Clean backfill will be used to fill the remaining open excavated area.

7.2 Permitting

Underground Injection Control

The Safe Drinking Water Act of 1974 and later amendments established the Federal Underground Injection Control (UIC) Program. The State of Missouri has obtained primacy from the US EPA for the UIC program. EPA has divided injection wells into five classes, based upon where the wells inject fluids in relation to Underground Sources of Drinking Water (USDW) and whether the injected fluids are hazardous or non-hazardous. The type of injection wells proposed for this project are considered Class V wells. Class V includes a variety of different well types and are also referred to as shallow injection wells. Some of these wells are regulated by the Division of Geology and Land Survey (DGLS) and certain types by the Water Pollution Control Program (WPCP). These wells are generally used to inject non-hazardous fluids into, or above, a USDW.

Groundwater remediation wells are a specific type of Class V wells. These injection wells are used in the cleanup of contaminated sites, and are permitted by the WPCP under the Missouri Clean Water Law, RSMo 644. For fuel spill cleanups, general permits are issued for projects that do not directly affect the groundwater. UIC site-specific permits are issued for projects determined by the state to directly affect the groundwater. UIC permit applications are reviewed in greater detail to assure maximum protection of groundwater resources. Other types of cleanup operations also require a site-specific UIC permit.

The permit application will be submitted to MO DNR following approval of this CAP.

7.3 Estimated Costs

The estimated capital and O&M costs for the bioremediation system and groundwater monitoring is presented in Table 3. The estimated capital costs for the soil excavation and off-site disposal are presented in Table 4. Supporting documentation for the cost estimates are included in Appendix D.

7.4 Required Plans

7.4.1 Work Plan

A Work Plan will be submitted to MO DNR prior to field activities. The Work Plan will present detailed procedures for excavation activities, remediation system construction, and monitoring well installation. The Work Plan will include a Sampling and Analysis Plan, Waste Management/Disposal Plan, Quality Assurance/Quality Control Plan, and Health and Safety Plan. Field work activities will not begin until the Work Plan has been reviewed and approved by MO DNR.

7.4.2 Operation and Maintenance Plan

A detailed O&M Plan will be submitted for the groundwater monitoring system upon completion of the system start-up. General descriptions of expected operation and maintenance activities are provided in the following subsections for the purpose of this conceptual design.

7.4.2.1 Training

Operation of the corrective measures will require training of key personnel involved in the installation and operation of the bioremediation and groundwater monitoring system. Training will be conducted prior to and during the initial start-up period. Training will also be incorporated into the O&M Plan documentation.

7.4.2.2 Maintenance Activities

Observation of system components will be conducted on a monthly basis. For the groundwater monitoring system, activities may include:

- Inspection of monitoring wells
- General housekeeping
- Scheduled maintenance and repairs as needed

7.4.2.3 O&M Plan Contents

An O&M plan will be prepared and submitted to MO DNR concurrently with the work plan. The following elements, at a minimum, will be addressed within the O&M Plan:

- Training of key personnel
- Description of the bioremediation application to the site
- Preventive maintenance program and schedules for groundwater monitoring wells
- Description of material applied to the site
- Description of groundwater monitoring equipment
- Records and reporting mechanisms required
- Contacts and phone numbers of manufacturers
- Safety Plan

7.4.3 Environmental Monitoring Plan

A detailed Environmental Monitoring Plan will be submitted to direct activities of the bioremediation and groundwater monitoring programs. Monitoring of the bioremediation system will include measuring and documenting dissolved oxygen and other biological parameters as part of the groundwater monitoring program. System monitoring will be performed at more frequent intervals at startup and during transient stages of operation. Groundwater contaminant monitoring as well as water quality monitoring will be performed on a semi-annual basis.

7.5 Schedule of Implementation

Implementation of remedial action will commence once approval of this CAP is received from the MO DNR. The first phase of the CAP will be application for necessary permits and completion of institutional controls for groundwater and soil and measures to complete all requirements for ETA. The second phase of CAP implementation will be the excavation of the contaminated soil. The third phase of the CAP will be preparation of system design plans and specifications and the construction of the bioremediation system. Concurrent with the operation of the bioremediation system, the groundwater monitoring program will be implemented. Initial start-up activities will include thorough system checks and performance evaluations. These activities will be documented and included in the O&M Plan for the system. Appendix E shows the Schedule of Implementation.

7.6 Reporting

Progress Reports will be submitted to the MO DNR during remedial action system construction and start-up phases in accordance with the schedule presented Appendix E. Progress Reports will also be prepared and submitted to the MO DNR throughout the operation of the remediation system. During the first year of operation, Progress Reports will be submitted quarterly. After the first year of operation with approval from the MO DNR, Progress Reports will be submitted to the MO DNR on a semi-annual basis. Groundwater monitoring information will be incorporated into the quarterly Progress Reports.

A Final Corrective Action Report will be prepared and submitted to the MO DNR once the remedial action objective for groundwater has been achieved at the site. The remedial action objective for soil will be met following excavation of contaminated soil and verification by off-site analysis. Attainment of groundwater cleanup standards will be demonstrated by three consecutive confirmation sampling events. Following MO DNR review and approval of the Final Corrective Action Report for the site, the remediation system will be decommissioned. Decommissioning will include removal of equipment and proper abandonment of any below-grade wells and/or piping.

8.0 REFERENCES

Missouri Department of Natural Resources, February 1992. Underground Storage Tank Corrective Action Guidance Document.

Missouri Department of Natural Resources, March 1996. Underground Storage Tank Closure Guidance Document.

US EPA, 1993a. In-Situ Bioremediation of Ground Water and Geological Material: A Review of Technologies. Office of Research and Development. EPA/5R-93/124.

Tables

TABLE 1
Summary of Soil
Analytical Results
GSA Hardesty
607 Hardesty Avenue, Kansas City, Missouri

Sample ID Date	HAR-SB01 (16-20) 27-Nov-00	HAR-SB02 (16-20) 28-Nov-00	HAR-SB03 (7-11) 28-Nov-00	HAR-SB03 (31-35) 28-Nov-00	HAR-SB04 (8-12) 28-Nov-00	HAR-SB04 (28-32) 28-Nov-00	HAR-SB05 (4-8) 28-Nov-00
Analytical Method							
EPA Method 8021A / OA1	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Gasoline Range Hydrocarbons	ND	**12**	**1,800**	**19**	ND	N/A	**250**
Benzene	ND	ND	**3.80**	**0.071**	ND	N/A	**0.57**
Toluene	ND	ND	**2.80**	ND	ND	N/A	ND
Ethylbenzene	ND	ND	**30**	**0.270**	ND	N/A	**1.10**
Xylene (total)	ND	ND	**76**	**0.710**	ND	N/A	**0.55**
Methyl-tert-butyl Ether	ND	ND	**9.50**	ND	ND	N/A	**0.46**
Method OA2	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Mineral Spirits	ND	ND	ND	ND	ND	N/A	ND
Jet Fuel	ND	ND	ND	ND	ND	N/A	ND
Kerosene	ND	ND	ND	ND	ND	N/A	ND
Diesel Fuel	ND	ND	ND	ND	ND	N/A	ND
Fuel Oil	ND	ND	ND	ND	ND	N/A	ND
Motor Oil	ND	ND	ND	ND	ND	N/A	ND
EPA Method 1311/6010	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
RCRA Lead, TCLP, Leach., ICP	N/A	N/A	N/A	ND	N/A	ND	N/A

ND - Not Detected
N/A - This sample was not analyzed for this parameter.
mg/L - milligrams per liter
mg/kg - milligrams per kilogram

TABLE 1
Summary of Soil
Analytical Results
GSA Hardesty
607 Hardesty Avenue, Kansas City, Missouri

Sample ID / **Date**	HAR-SB06 (8-12) 29-Nov-00	HAR-SB06 (16-20) 29-Nov-00	HAR-SB07 (8-12) 29-Nov-00	HAR-SB07 (36-40) 29-Nov-00	HAR-SB08 (20-24) 29-Nov-00	HAR-SB09 (8-12) 29-Nov-00	HAR-SB10 (8-12) 08-Nov-00
Analytical Method							
EPA Method 8021A / OA1	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Gasoline Range Hydrocarbons	**420**	N/A	**160**	N/A	ND	**250**	**84**
Benzene	**0.63**	N/A	**0.26**	N/A	ND	**0.67**	**0.21**
Toluene	ND	N/A	ND	N/A	ND	ND	ND
Ethylbenzene	**8.20**	N/A	**1.30**	N/A	ND	**2.40**	**0.32**
Xylene (total)	**3.00**	N/A	**0.23**	N/A	ND	ND	**0.22**
Methyl-tert-butyl Ether	**1.70**	N/A	ND	N/A	ND	ND	ND
Method OA2	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Mineral Spirits	ND	N/A	ND	N/A	ND	ND	ND
Jet Fuel	ND	N/A	ND	N/A	ND	ND	ND
Kerosene	ND	N/A	ND	N/A	ND	ND	ND
Diesel Fuel	ND	N/A	ND	N/A	ND	ND	ND
Fuel Oil	ND	N/A	ND	N/A	ND	ND	ND
Motor Oil	ND	N/A	ND	N/A	ND	ND	ND
EPA Method 1311/6010	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
RCRA Lead, TCLP, Leach., ICP	N/A	ND	N/A	ND	N/A	N/A	N/A

ND - Not Detected
N/A - This sample was not analyzed for this parameter.
mg/L - milligrams per liter
mg/kg - milligrams per kilogram

TABLE 1
Summary of Soil
Analytical Results
GSA Hardesty
607 Hardesty Avenue, Kansas City, Missouri

Sample ID **Date**	HAR-SB12 (8-12) 30-Nov-00	HAR-SB12 (20-24) 30-Nov-00	HAR-SB13 (8-12) 30-Nov-00	HAR-SB13 (20-24) 30-Nov-00	HAR-SB14 (12-16) 30-Nov-00	HAR-DP01 30-Nov-00	HAR-SB15 (20-24) 30-Nov-00
Analytical Method							
EPA Method 8021A / OA1	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Gasoline Range Hydrocarbons	**180**	N/A	**200**	N/A	**480**	**400**	**65**
Benzene	**0.29**	N/A	**0.37**	N/A	**0.99**	**0.66**	**0.18**
Toluene	ND	N/A	ND	N/A	ND	ND	ND
Ethylbenzene	**1.30**	N/A	**2.00**	N/A	**4.60**	**2.80**	**0.34**
Xylene (total)	**0.32**	N/A	**1.00**	N/A	**1.40**	**0.68**	ND
Methyl-tert-butyl Ether	ND	N/A	ND	N/A	ND	ND	ND
Method OA2	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Mineral Spirits	ND	N/A	ND	N/A	ND	ND	ND
Jet Fuel	ND	N/A	ND	N/A	ND	ND	ND
Kerosene	ND	N/A	ND	N/A	ND	ND	ND
Diesel Fuel	ND	N/A	ND	N/A	ND	ND	ND
Fuel Oil	ND	N/A	ND	N/A	ND	ND	ND
Motor Oil	ND	N/A	ND	N/A	ND	ND	ND
0							
EPA Method 1311/6010	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
RCRA Lead, TCLP, Leach., ICP	N/A	ND	N/A	ND	N/A	N/A	N/A

ND - Not Detected
N/A - This sample was not analyzed for this parameter.
mg/L - milligrams per liter
mg/kg - milligrams per kilogram

TABLE 1
Summary of Soil
Analytical Results
GSA Hardesty
607 Hardesty Avenue, Kansas City, Missouri

Sample ID Date	HAR-SB16 (16-20) 30-Nov-00	HAR-SB17 (8-12) 30-Nov-00	HAR-SB18 (16-20) 01-Dec-00	HAR-DP02 01-Dec-00	HAR-SB11 (8-12) 01-Dec-00	HAR-SB19 (12-16) 01-Dec-00	HAR-SB20 (12-16) 01-Dec-00
Analytical Method							
EPA Method 8021A / OA1	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Gasoline Range Hydrocarbons	ND	**23**	ND	ND	**9.80**	ND	**1,100**
Benzene	ND	**0.052**	ND	ND	ND	ND	**1.40**
Toluene	ND	ND	**0.053**	ND	ND	ND	ND
Ethylbenzene	ND	**0.094**	ND	ND	ND	ND	**18**
Xylene (total)	ND	ND	ND	ND	ND	ND	**13**
Methyl-tert-butyl Ether	ND	ND	ND	ND	ND	ND	**4.50**
Method OA2	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Mineral Spirits	ND	ND	ND	ND	ND	ND	ND
Jet Fuel	ND	ND	ND	ND	ND	ND	ND
Kerosene	ND	ND	ND	ND	ND	ND	ND
Diesel Fuel	ND	ND	ND	ND	ND	ND	ND
Fuel Oil	ND	ND	ND	ND	ND	ND	ND
Motor Oil	ND	ND	ND	ND	ND	ND	ND
EPA Method 1311/6010	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
RCRA Lead, TCLP, Leach., ICP	N/A	N/A	N/A	N/A	N/A	N/A	N/A

ND - Not Detected
N/A - This sample was not analyzed for this parameter.
mg/L - milligrams per liter
mg/kg - milligrams per kilogram

TABLE 1
Summary of Soil
Analytical Results
GSA Hardesty
607 Hardesty Avenue, Kansas City, Missouri

Sample ID	HAR-SB21 (16-20)	HAR-SB22 (16-20)	HAR-SB23 (12-16)
Date	01-Dec-00	01-Dec-00	04-Dec-00
Analytical Method			
EPA Method 8021A / OA1	mg/kg	mg/kg	mg/kg
Gasoline Range Hydrocarbons	**14**	ND	ND
Benzene	**0.077**	ND	ND
Toluene	ND	ND	ND
Ethylbenzene	**0.019**	ND	ND
Xylene (total)	ND	ND	ND
Methyl-tert-butyl Ether	ND	ND	ND
Method OA2	mg/kg	mg/kg	mg/kg
Mineral Spirits	ND	ND	ND
Jet Fuel	ND	ND	ND
Kerosene	ND	ND	ND
Diesel Fuel	ND	ND	ND
Fuel Oil	ND	ND	ND
Motor Oil	ND	ND	ND
EPA Method 1311/6010	mg/L	mg/L	mg/L
RCRA Lead, TCLP, Leach., ICP	N/A	N/A	N/A

ND - Not Detected
N/A - This sample was not analyzed for this parameter.
mg/L - milligrams per liter
mg/kg - milligrams per kilogram

TABLE 1
Summary of Soil
Analytical Results
GSA Hardesty
607 Hardesty Avenue, Kansas City, Missouri

Sample ID	HAR-SP01	HAR-SP02	HAR-SP03	HAR-SP04	HAR-SP05
Date	08-Dec-00	08-Dec-00	08-Dec-00	08-Dec-00	08-Dec-00
Analytical Method					
EPA Method 8021A / OA1	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzene	**0.059**	ND	**0.064**	ND	ND
Toluene	**0.27**	**0.14**	**0.26**	**0.079**	**0.062**
Ethylbenzene	**0.14**	ND	**0.096**	**0.062**	ND
Xylene (total)	**1.3**	**0.46**	**0.87**	**0.51**	**0.29**
1,2 - Dichloroethane	ND	ND	ND	ND	ND
EPA Method 1311/6010	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Total Lead	**65.6**	**1,130**	**81.4**	**84.8**	**84.1**

ND - Not Detected
N/A - This sample was not analyzed for this parameter.
mg/kg - milligrams per kilogram

TABLE 2
Summary of Groundwater Analytical Results
GSA Hardesty
607 Hardesty Avenue, Hardesty, MO

Sample ID Date	HAR-MW1 07-Dec-00	HAR-MW2 07-Dec-00	HAR-MW3 07-Dec-00	HAR-MW4 07-Dec-00	HAR-MW5 07-Dec-00	HAR-MW6 07-Dec-00	HAR-MW7 08-Dec-00	HAR-MW8 07-Dec-00	HAR-MW9 08-Dec-00	HAR-MW10 30-May-01	HAR-DP05 07-Dec-00	HAR-DP06 08-Dec-00
Analytical Method												
EPA Method 8021A / OA1	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Gasoline Range Hydrocarbons	**12.600**	**1.290**	ND	ND	**1.040**	ND	ND	**2.540**	ND	ND	**1.030**	ND
Benzene	**1.620**	**0.004**	ND	ND	**0.003**	ND	ND	ND	ND	ND	ND	ND
Toluene	**0.242**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	**0.829**	**0.026**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	**1.080**	**0.005**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl-tert-butyl Ether	ND	**0.010**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Method OA2	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Mineral Spirits	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Jet Fuel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kerosene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diesel Fuel	ND	ND	ND	ND	**9.0**	ND	**14**	**31**	ND	ND	**39**	ND
Fuel Oil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Motor Oil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND - Not Detected
µg/l - micrograms per liter
mg/l - milligrams per liter

TABLE 3
Summary of Costs for Alternative 2
GSA Hardesty
607 Hardesty Avenue, Kansas City, Missouri

Category/Task			Estimated Cost
Engineering Services			$200,777.50
Site Restoration			$2,396.30
Mobilization/Demobilization			$23,250.00
		Subtotal Project Costs	$226,423.80
Design and Engineering	Estimated as 10 percent of subtotal project costs		$22,642.38
Site Safety and Health	Estimated as 5 percent of subtotal project costs		$11,321.19
Construction Oversight	Estimated as 10 percent of subtotal project costs		$22,642.38
Permitting	Estimated as 5 percent of subtotal project costs		$11,321.19
Unlisted Items	15 percent of subtotal project costs		$33,963.57
		Estimated Capital Cost	**$328,314.51**
		Estimated O&M Cost (yearly)	**$31,632.00**
Estimated 5 Year Present Worth Costs			**$465,265.25**

TABLE 4
Summary of Costs for Alternative 4
GSA Hardesty
607 Hardesty Avenue Kansas City, Missouri

Category/Task			Estimated Cost
Engineering Services			$180,603.13
Site Restoration			$87,400.55
Mobilization/Demobilization			$23,250.00
		Subtotal Project Costs	$291,253.68
Design and Engineering	Estimated as 10 percent of subtotal project costs		$29,125.37
Site Safety and Health	Estimated as 5 percent of subtotal project costs		$14,562.68
Construction Oversight	Estimated as 10 percent of subtotal project costs		$29,125.37
Permitting	Estimated as 5 percent of subtotal project costs		$14,562.68
Unlisted Items	15 percent of subtotal project costs		$43,688.05
		Estimated Capital Cost	**$422,317.84**

TABLE 5
Summary of Excavation Parameters and Calculations
GSA Hardesty
607 Hardest Avenue Kansas City, Missouri

Zone	Area (ft2)	Depth (ft)	Volume (ft3)	Volume (yd3)	Tonnage[1]
Clean Soil	6,500	6	39,000	1,445	2,168
Contaminated Soil[2]	6,500	18	117,000	4,333	6,500
Slope[3]			24,000	889	1,334
Total Soil Excavated			180,000	6,667	10,001

Notes:
1) Tons are determined by multiplying the cubic yards by 1.5.
2) Contaminated Soil Estimate is based on a clean top layer of soil from 0-6 feet bls.
This portion will be transported off-site for disposal.
3) Slope is calculated at a 1:5 ratio (70 degree slope).

Figures

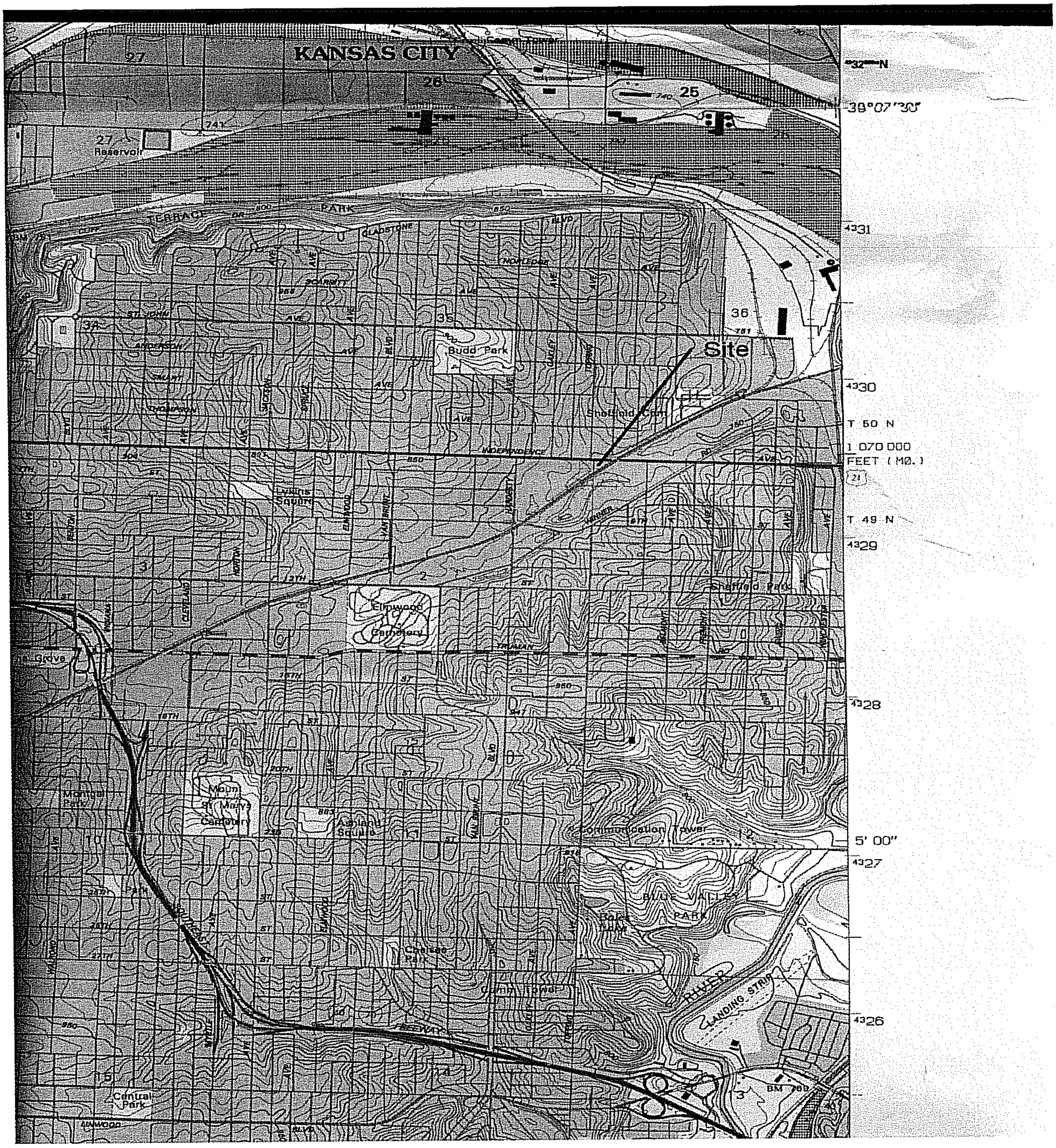
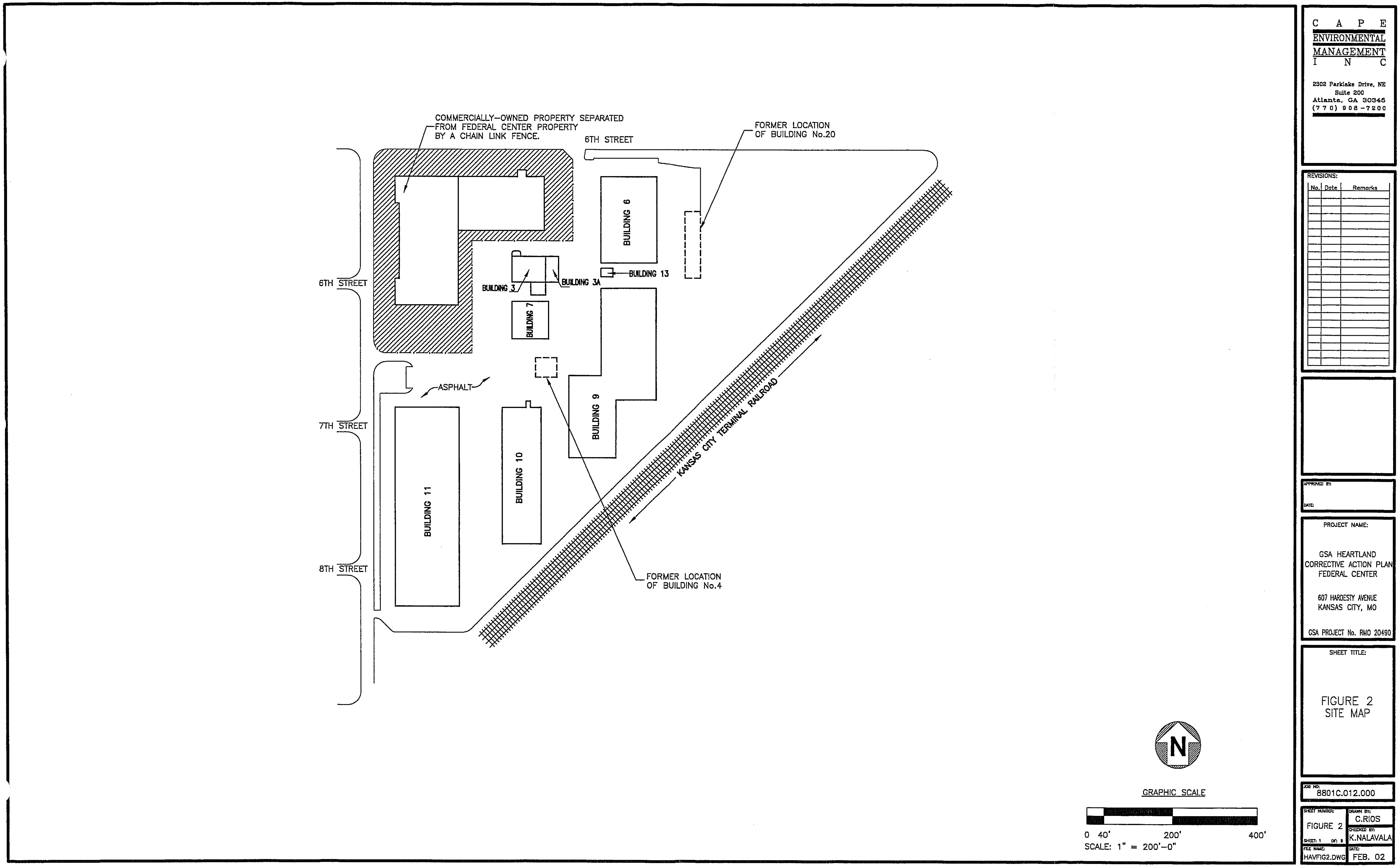


Figure 1 USGS 7.5 Minute Topographic Map
Kansas City, MO-KS
1991


COMMERCIALLY-OWNED PROPERTY SEPARATED FROM FEDERAL CENTER PROPERTY BY A CHAIN LINK FENCE.
6TH STREET
FORMER LOCATION OF BUILDING No.20
BUILDING 6
BUILDING 13
BUILDING 3
BUILDING 3A
6TH STREET
BUILDING 7
ASPHALT
BUILDING 9
7TH STREET
BUILDING 10
BUILDING 11
KANSAS CITY TERMINAL RAILROAD
8TH STREET
FORMER LOCATION OF BUILDING No.4
N
GRAPHIC SCALE
0 40' 200' 400'
SCALE: 1" = 200'-0"
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2302 Parklake Drive, NE
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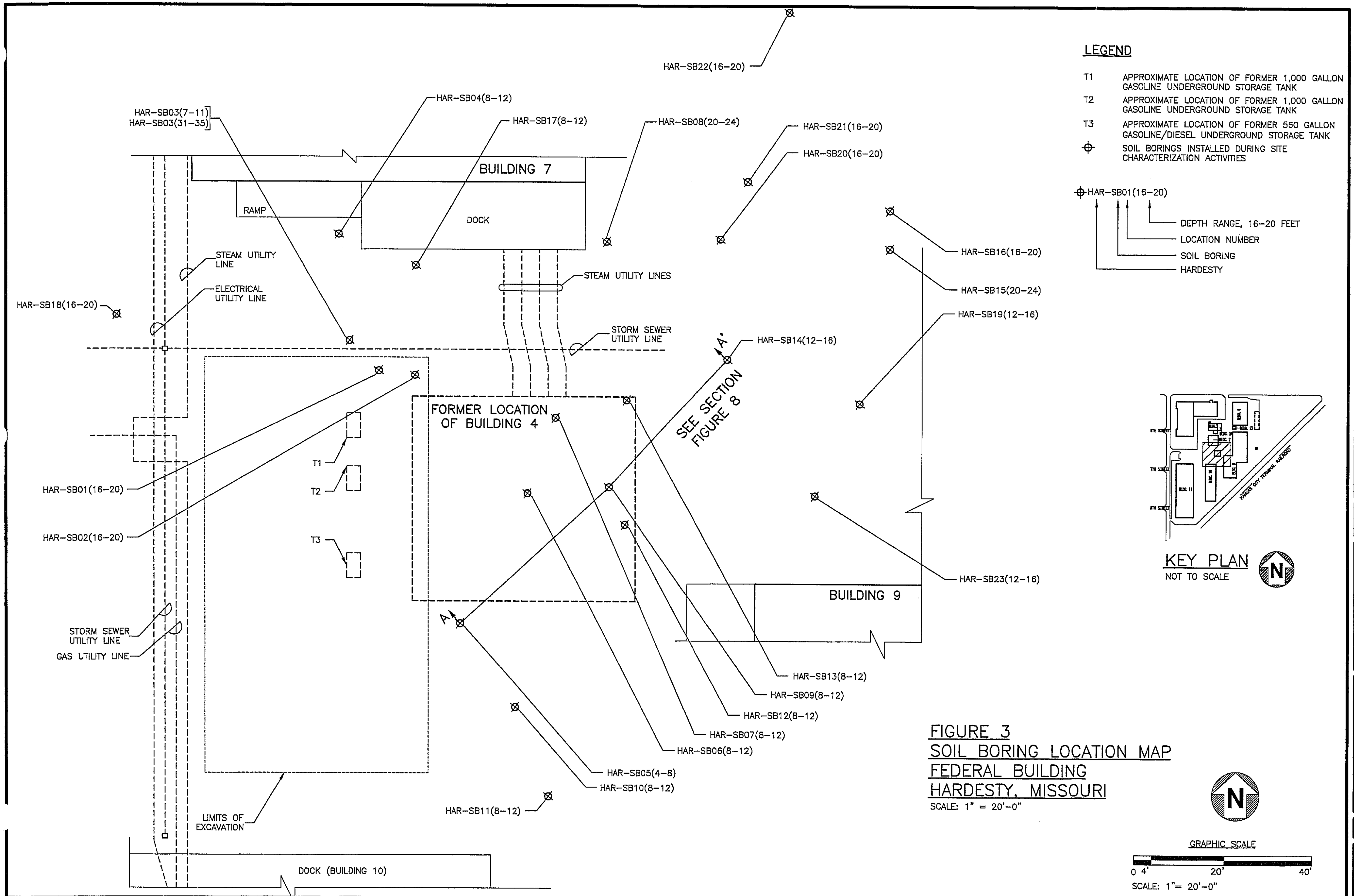
No. Date Remarks
APPROVED BY:
DATE:
PROJECT NAME:
GSA HEARTLAND
CORRECTIVE ACTION PLAN
FEDERAL CENTER
607 HARDESTY AVENUE
KANSAS CITY, MO
GSA PROJECT No. RMO 20490
SHEET TITLE:
FIGURE 2
SITE MAP
JOB NO:
8801C.012.000
SHEET NUMBER:
FIGURE 2
SHEET: 1 OF: 9
DRAWN BY:
C.RIOS
CHECKED BY:
K.NALAVALA
FILE NAME:
HAVFIG2.DWG
DATE:
FEB. 02



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No.	Date	Remarks

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PROJECT NAME:

GSA HEARTLAND CORRECTIVE ACTION PLAN FEDERAL CENTER

607 HARDESTY AVENUE
KANSAS CITY, MO

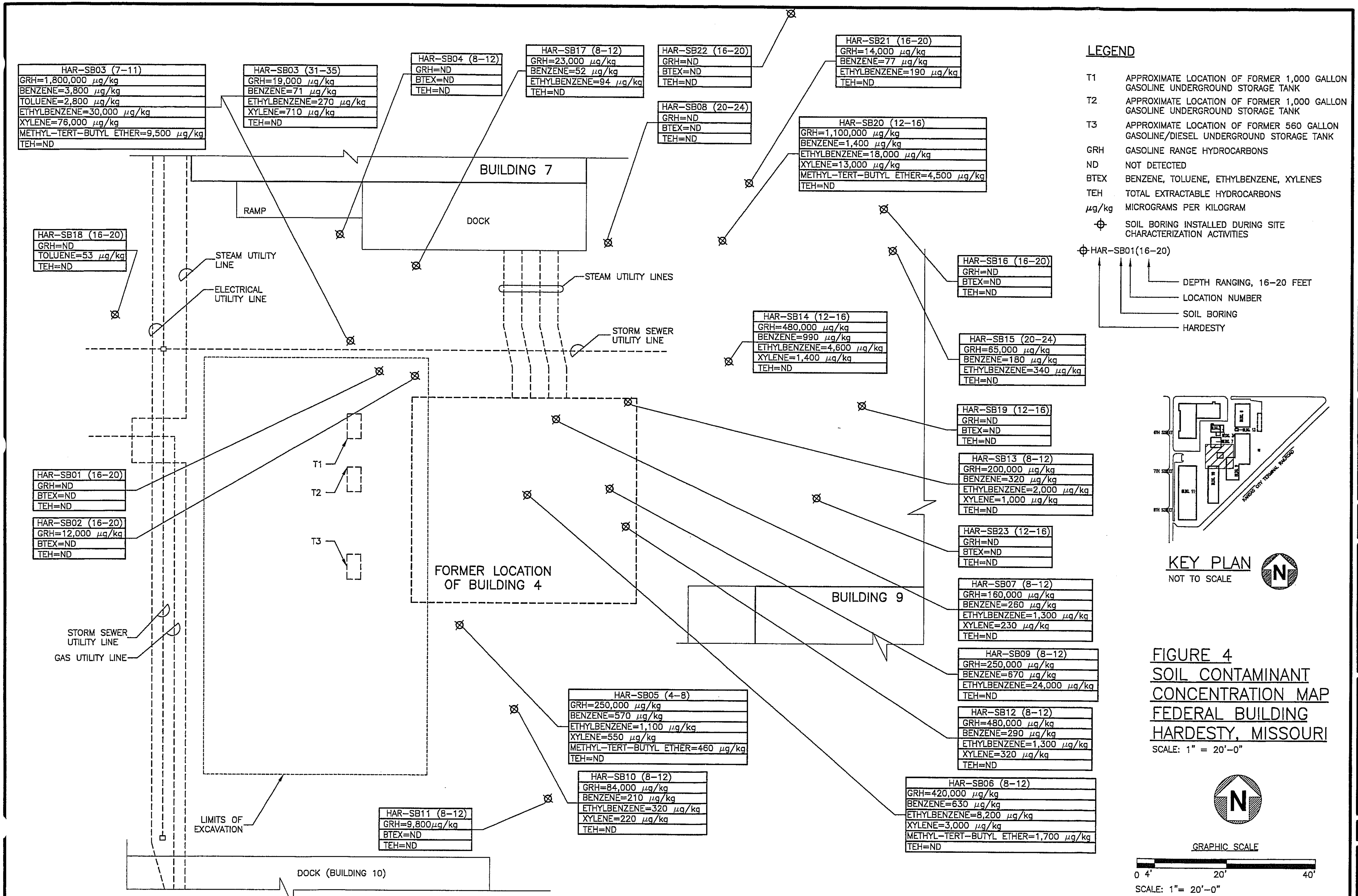
GSA PROJECT No. RMO 20490

SHEET TITLE:

FIGURE 3
SOIL BORING LOCATION MAP

JOB NO: 8801C.012.000

SHEET NUMBER: FIGURE 3
SHEET: 2 OF: 9
DRAWN BY: C.RIOS
CHECKED BY: K.NALAVALA
FILE NAME: HAVFIG3.DWG
DATE: FEB. 02



CAPE ENVIRONMENTAL MANAGEMENT INC

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(770) 908-7200

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No.	Date	Remarks

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PROJECT NAME:

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607 HARDESTY AVENUE KANSAS CITY, MO

GSA PROJECT No. RMO 20490

SHEET TITLE:

FIGURE 4 SOIL CONTAMINANT CONCENTRATION MAP

JOB NO: 8801C.012.000

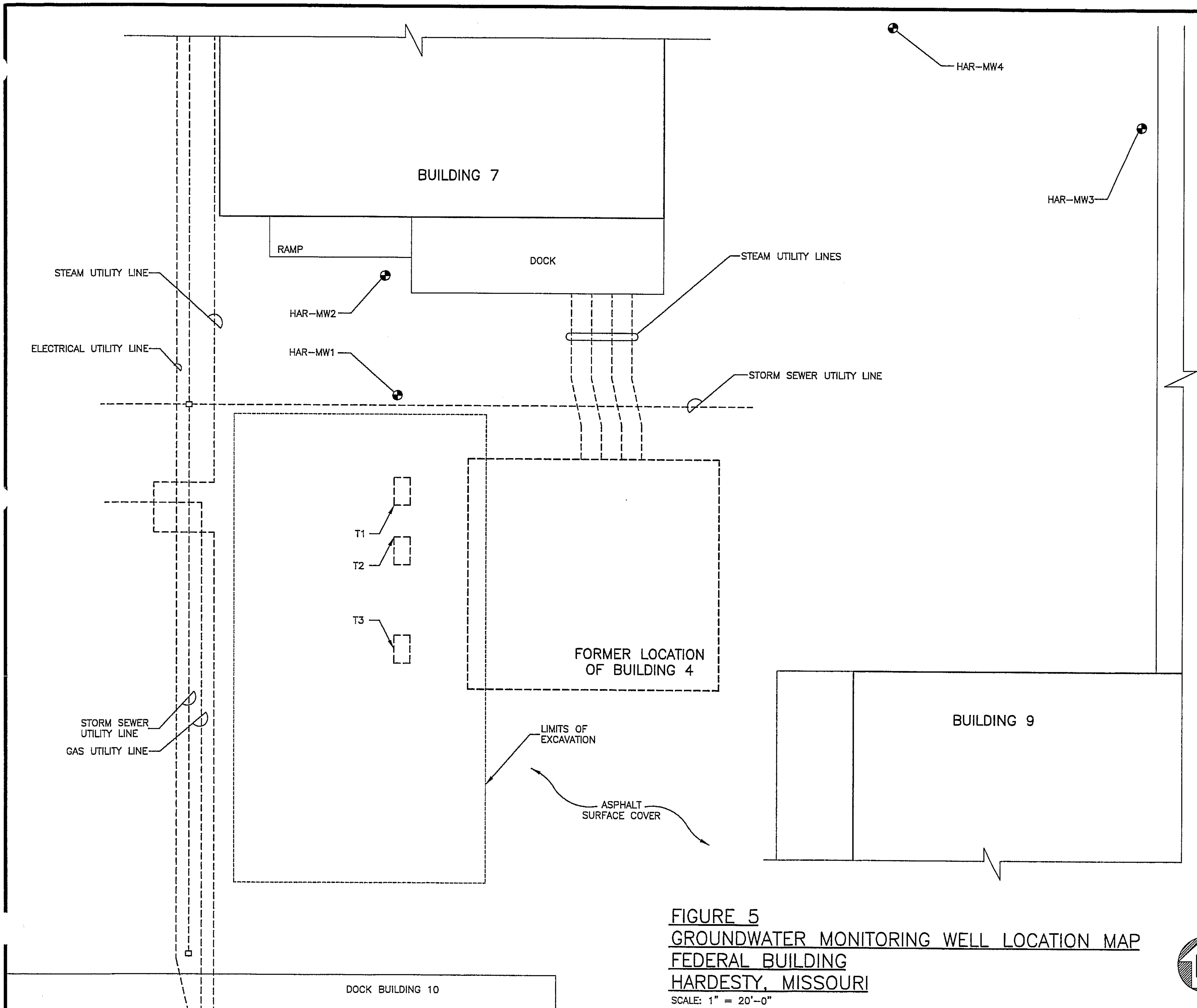
SHEET NUMBER: FIGURE 4 — SHEET: 3 OF: 9

DRAWN BY: C.RIOS

CHECKED BY: K.NALAVALA

FILE NAME: HAVFIG4.DWG

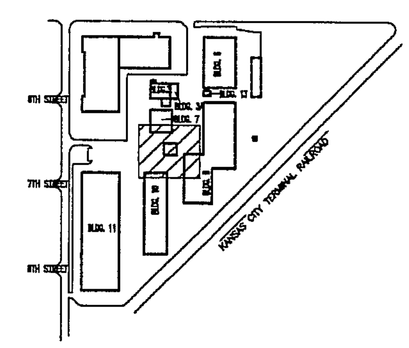
DATE: FEB. 02



LEGEND

T1	APPROXIMATE LOCATION OF FORMER 1,000 GALLON GASOLINE UNDERGROUND STORAGE TANK
T2	APPROXIMATE LOCATION OF FORMER 1,000 GALLON GASOLINE UNDERGROUND STORAGE TANK
T3	APPROXIMATE LOCATION OF FORMER 560 GALLON GASOLINE/DIESEL UNDERGROUND STORAGE TANK
⊕	MONITORING WELLS INSTALLED DURING SITE CHARACTERIZATION ACTIVITIES

HAR-MW1
- LOCATION NUMBER
- MONITORING WELL DESIGNATION
- HARDESTY



KEY PLAN
NOT TO SCALE

FIGURE 5
GROUNDWATER MONITORING WELL LOCATION MAP
FEDERAL BUILDING
HARDESTY, MISSOURI

SCALE: 1" = 20'-0"

GRAPHIC SCALE
0 4' 20' 40'
SCALE: 1"= 20'-0"

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GSA PROJECT No. RMO 20490

SHEET TITLE:
FIGURE 5
GROUNDWATER MONITORING
WELL LOCATION MAP

JOB NO: 8801C.012.000

SHEET NUMBER: FIGURE 5	DRAWN BY: C.RIOS	
SHEET: 4 OF: 8	CHECKED BY: K.NALAVALA	
FILE NAME: HAVFIG5.DWG	DATE: FEB. 02	

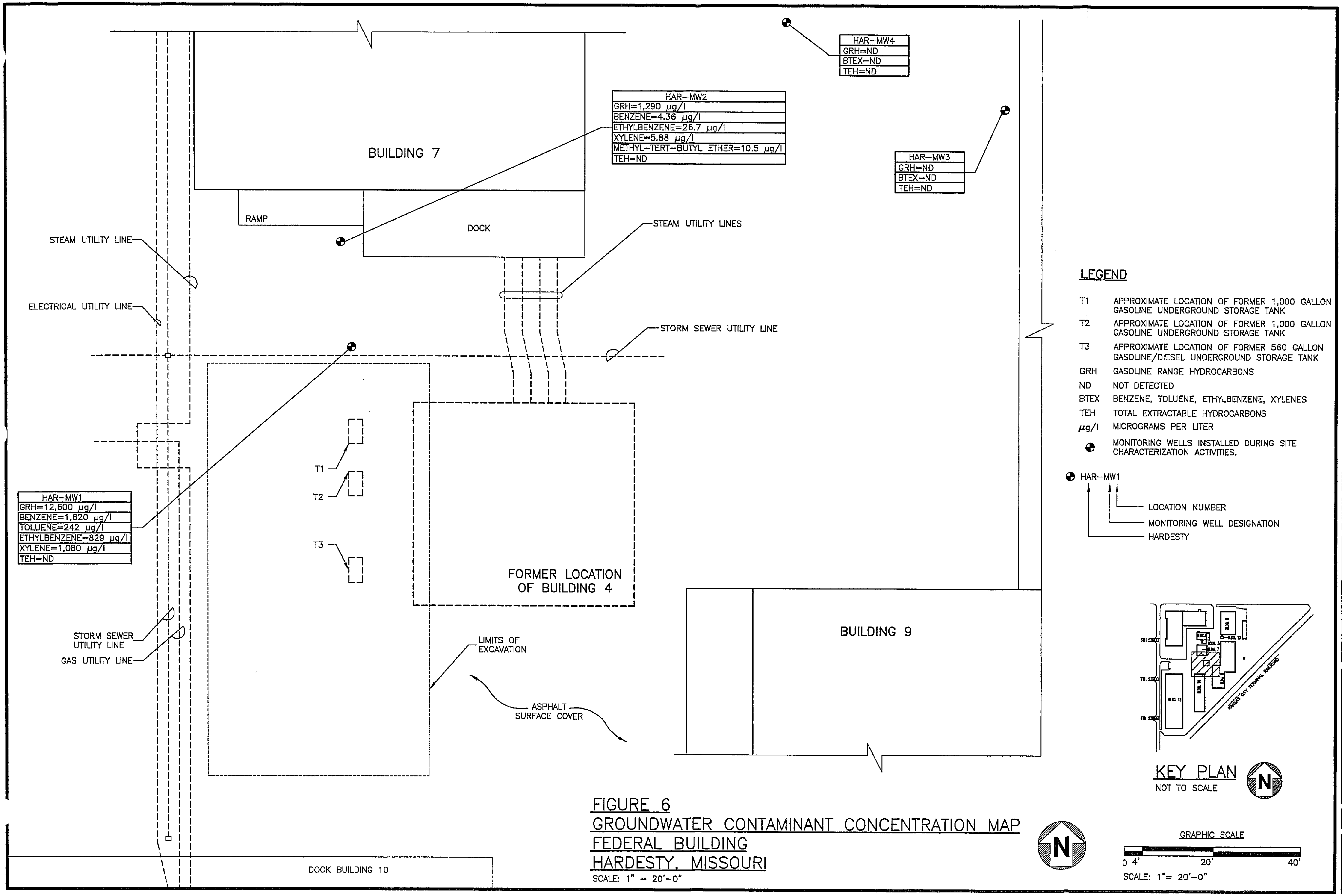

FIGURE 6
GROUNDWATER CONTAMINANT CONCENTRATION MAP
FEDERAL BUILDING
HARDESTY, MISSOURI
SCALE: 1" = 20'-0"

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FEDERAL CENTER

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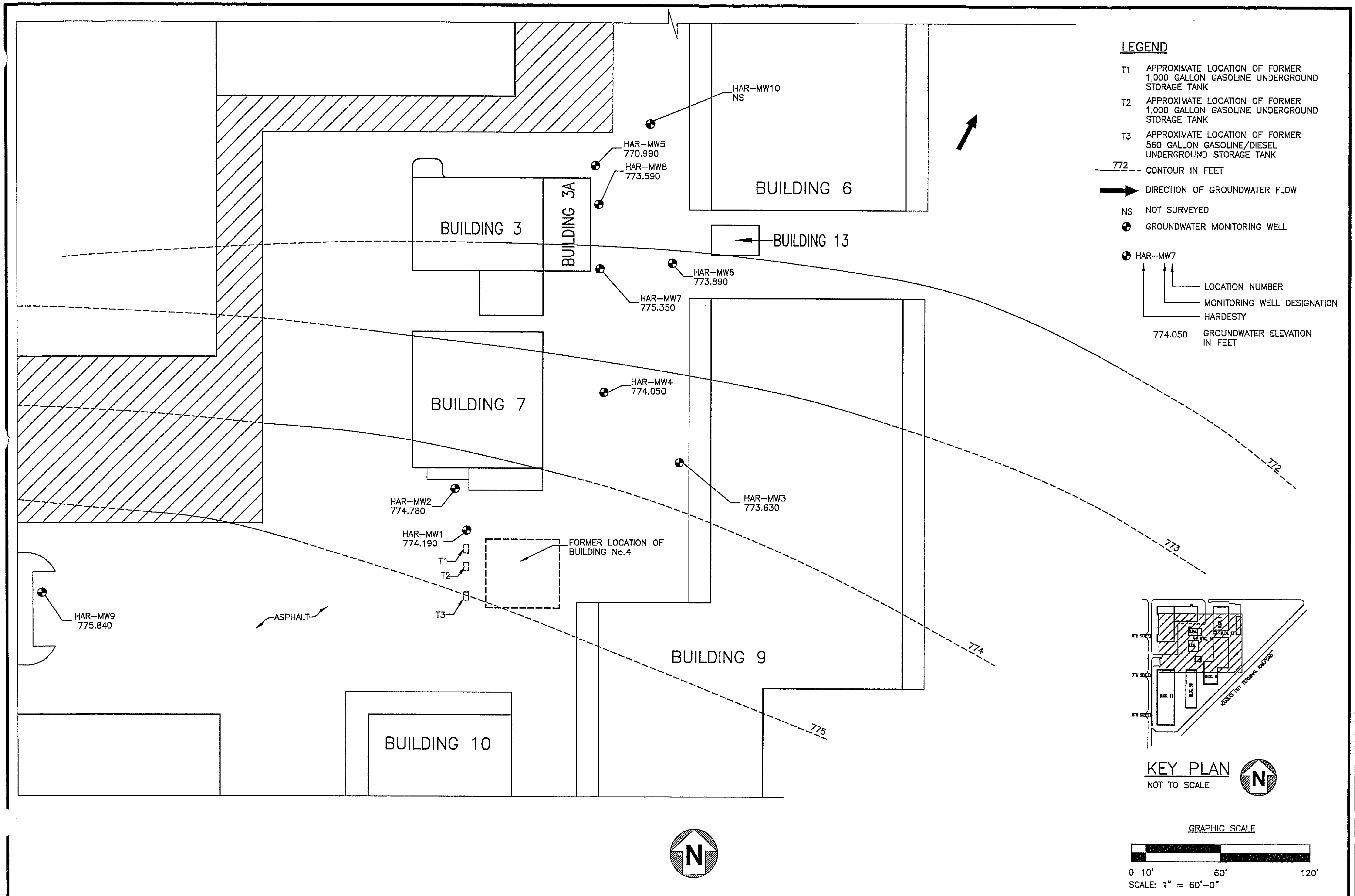
KANSAS CITY, MO

GSA PROJECT No. RMO 20490

SHEET TITLE:
FIGURE 6
GROUNDWATER CONTAMINANT
CONCENTRATION MAP

JOB NO: 8801C.012.000
SHEET NUMBER: FIGURE 6
SHEET: 5 OF: 8
DRAWN BY: C.RIOS
CHECKED BY: K.NALAVALA
FILE NAME: HAVFIG6.DWG
DATE: FEB. 02



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No.	Date	Remarks

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PROJECT NAME:

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FEDERAL CENTER

607 HARDESTY AVENUE
KANSAS CITY, MO

GSA PROJECT No. RMO 20490

SHEET TITLE:

FIGURE 7
POTENTIOMETRIC
SURFACE MAP

JOB NO: 8801C.012.000

SHEET NUMBER: FIGURE 7

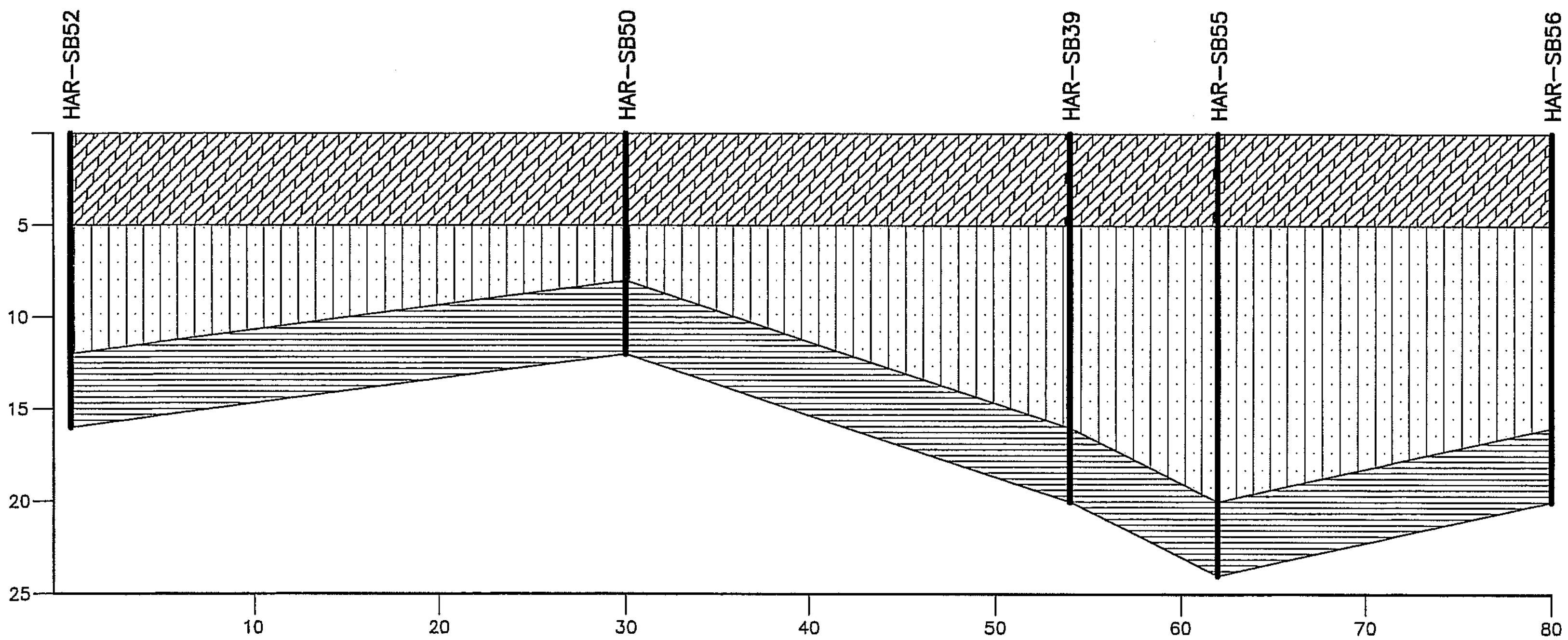
SHEET: 8 OF: 9

DRAWN BY: C.RIOS

CHECKED BY: K.NALAVALA

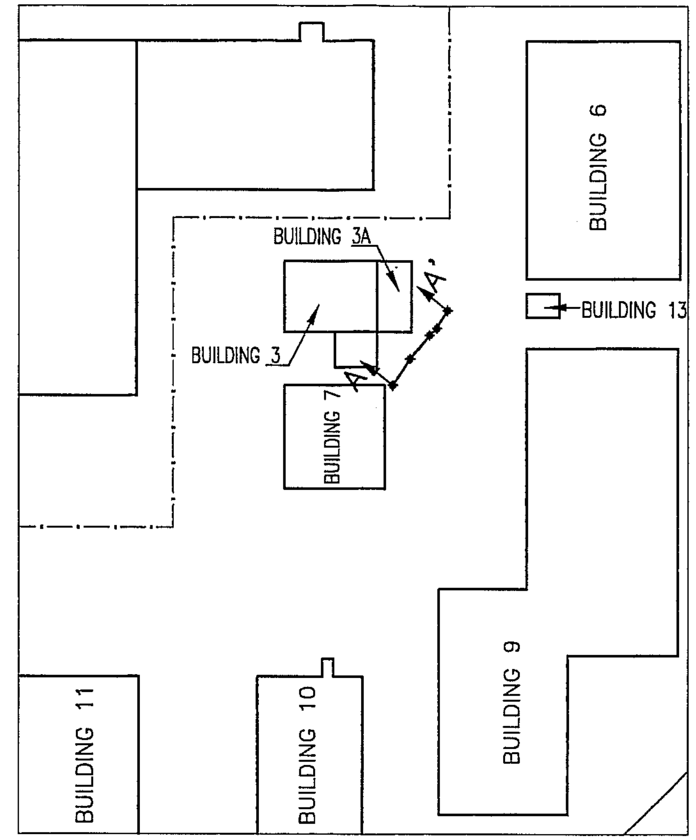
FILE NAME: HAVFIG7.DWG

DATE: FEB. 02



CROSS SECTION A-A'

SCALE AS SHOWN



PLAN VIEW

NOT TO SCALE

LEGEND

SAND SILTY CLAY

SILTY CLAY

FREE PHASE HYDROCARBONS

WATER TABLE

GRAPHIC SCALE

VERTICAL

1' 5' 10'

SCALE: 1"= 5'-0"

GRAPHIC SCALE

HORIZONTAL

0 2' 10' 20'

SCALE: 1"= 10'-0"

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FEDERAL CENTER

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KANSAS CITY, MO

GSA PROJECT No. RMO 20490

SHEET TITLE:

FIGURE 8
CROSS SECTION

JOB NO: 8801C.012.000

SHEET NUMBER: FIGURE 8

SHEET: 8 OF: 10

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FILE NAME: HAVFIG8.DWG

DATE: NOV. 01

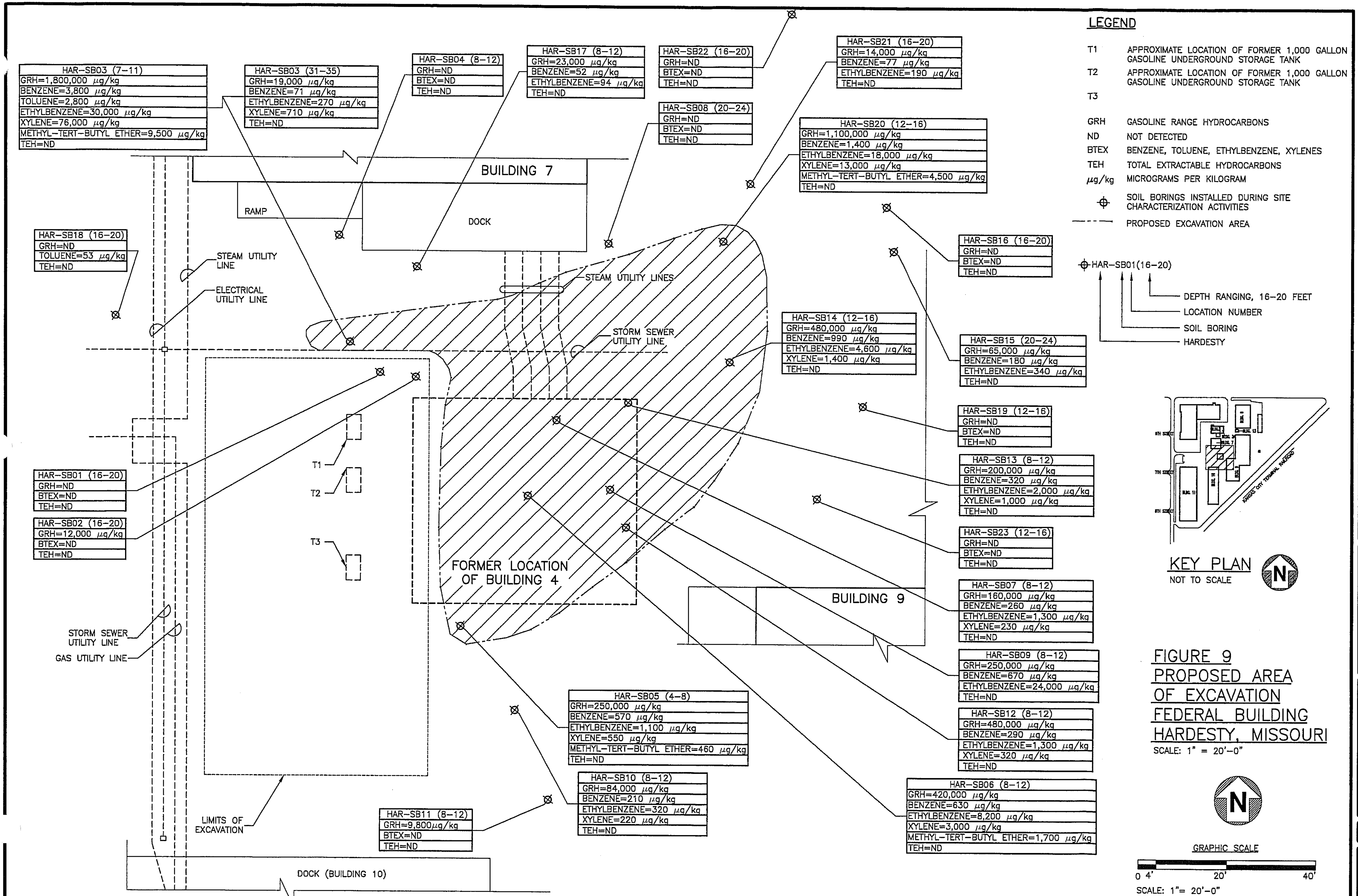


FIGURE 9
PROPOSED AREA OF EXCAVATION
FEDERAL BUILDING
HARDESTY, MISSOURI

SCALE: 1" = 20'-0"

CAPE ENVIRONMENTAL MANAGEMENT INC
2302 Parklake Drive, NE
Suite 200
Atlanta, GA 30345
(770) 908-7200

REVISIONS:

No.	Date	Remarks

APPROVED BY:

DATE:

PROJECT NAME:

GSA HEARTLAND CORRECTIVE ACTION PLAN FEDERAL CENTER

607 HARDESTY AVENUE
KANSAS CITY, MO

GSA PROJECT No. RMO 20490

SHEET TITLE:

FIGURE 9 PROPOSED AREA OF EXCAVATION

JOB NO: 8801C.012.000

SHEET NUMBER: FIGURE 9 SHEET: 8 OF: 9

DRAWN BY: C.RIOS

CHECKED BY: K.NALAVALA

FILE NAME: HAVFIG9.DWG

DATE: FEB. 02

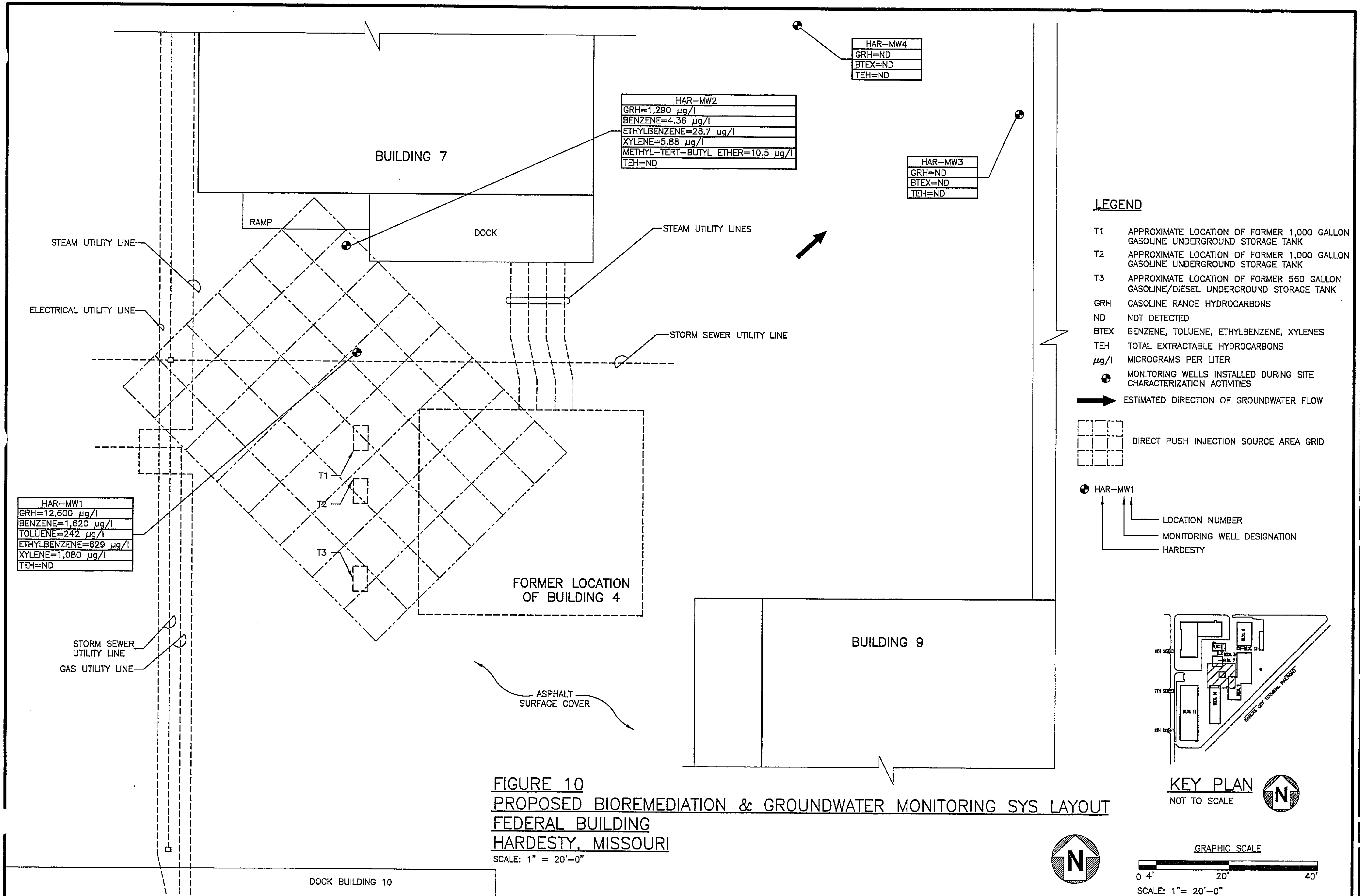


FIGURE 10
PROPOSED BIOREMEDIATION & GROUNDWATER MONITORING SYS LAYOUT
FEDERAL BUILDING
HARDESTY, MISSOURI
SCALE: 1" = 20'–0"

CAPE ENVIRONMENTAL MANAGEMENT INC
2302 Parklake Drive, NE
Suite 200
Atlanta, GA 30345
(770) 908–7200

REVISIONS:		
No.	Date	Remarks

APPROVED BY:
DATE:

PROJECT NAME:
GSA HEARTLAND CORRECTIVE ACTION PLAN FEDERAL CENTER
607 HARDESTY AVENUE KANSAS CITY, MO
GSA PROJECT No. RMO 20490

SHEET TITLE:
FIGURE 10
PROPOSED BIOREMEDIATION AND GROUNDWATER MONITORING SYSTEM LAYOUT

JOB NO: 8801C.012.000
SHEET NUMBER: FIGURE 10
DRAWN BY: C.RIOS
CHECKED BY: K.NALAVALA
FILE NAME: HAVFIG10
DATE: FEB. 02

Appendix A

Missouri Corrective Action Checklist

MISSOURI CORRECTIVE ACTION PLAN CHECKLIST

GENERIC REQUIREMENTS

Date of submittal of CAP: April 30, 2002

Site Name: Gasoline USTs at Federal Building #4

UT number: ______ LU number: ______

Location: 607 Hardesty Avenue, Kansas City, Jackson County, Missouri 64124-3032

Owner/operator: General Services Administration Phone: 816-823-2227 David Hartsthorne

Contractor: Cape Environmental Management Inc Phone: 800-488-4372

Page	Topic
1-3	Incorporation of previous corrective action activities or interim measures into Plan (e.g., free product recovery, vapor reduction in basements)
2-1	Summary of Site Characterization Report
2-3	sampling results
2-6	pathways and receptors
2-5	release characteristics
Fig.2	Detailed site plan provided
3-8	Cleanup levels determined
4-1	Three corrective action alternatives discussed
5-2	Justification for selection of corrective action
7-1	Engineering design provided
	process flow diagram of equipment
7-1	narrative description of process
	Operation and maintenance plan provided
	Environmental monitoring plan provided
	QA/QC plan for sampling and analysis
	Health and safety plan provided
	Waste management/disposal plan provided, including estimated volumes
	soil
	process water
	tank
	sludges
	free product
7-10	Complete lists of permits to be obtained, and discussion
Ap.E	Overall time schedule for all corrective action activities
6-10	Conclusion

Appendix B

Site Sensitivity Score

Site Sensitivity Score

GSA Hardesty
607 Hardesty Avenue
Kansas City, Mo

Site Features	Score 15 If True		Score 10 If True		Score 5 If True		Score 0 If True	
Groundwater Potable?	No	T	Unknown		Poor		Yes	
Depth to Groundwater	>100 ft		51-100 ft		25-50 ft		<25 ft	T
Natural Fractures Present?	None		Unknown	T	Present		Predominant	
Man-made vertical Conduits?	None	T	Unknown		Present		Predominant	
Man-made horizontal Conduits?	None		Unknown		Present	T	Predominant	
Coarse soil or sand present?	None	T	Unknown		Present		Predominant	
Water Wells nearby?	>1000 ft	T	501-1000 ft away		100-500 ft away		<100 ft away	
Background levels present?	above action levels		Unknown		Below action levels	T	nondetectable	
Subtotals		60		10		10		0
					Total Score =			**80**

Soil Cleanup (ppm)				
Total score	101-120	**71-100**	41-70	40or less
BTEX =	2/10/50/50	**1/5/10/10**	0.5/1/2/2	B+T+E+X<2
TPH =	500	**200**	100	50

Notes:
T= True
Bold = soil cleanup criteria

Appendix C

Engineering Calculations and Slug Test Data

Engineering Calculations

Assumptions:
Flow velocity calculated using geometric K average from slug test data and Porosity assumed to be 0.30 (Fetter C.W. 1998, Applied Hydrogeology, Merill Publishing Company, New Jersey)

Calculations:

Note: Using Hvorslev Method to determine hydraulic conductivity

K is hydraulic Conductivity (ft/day)
r is the radius of the well casing (ft)
R is the radius of well screen (ft)
Le is the length of the well screen (ft)
To is the time it takes for the water level to rise or fall to 37 percent of the initial change (seconds)

Test-1

$$K = \frac{r^2 \ln(Le/R)}{2LeTo}$$

$$= \frac{0.006944 \times \ln(34/0.1667)}{2 \times 34 \times 1980}$$

$$= \mathbf{2.74 \times 10^{-7}\ ft/sec}$$

Test-2

$$K = \frac{r^2 \ln(Le/R)}{2LeTo}$$

$$= \frac{0.006944 \times \ln(34/0.1667)}{2 \times 34 \times 3540}$$

$$= \mathbf{1.53 \times 10^{-7}\ ft/sec}$$

Calculating Geometric Mean of K:

Hydraulic conductivity (K)	ln (K)
2.74×10^{-7}	-15.110
1.53×10^{-7}	-15.692
Sum: 1.71×10^{-5}	-30.802
mean ln(K):	-30.802/2 = -15.401
Geometric Mean = Exp[mean ln(K)]	$e^{-15.401}$ = **2.04×10^{-7} ft/sec**

Hydraulic Conductivity (K) = 2.04×10^{-7} ft/sec or 0.01762 ft/day

<u>**Seepage velocity (Vs)**</u>

$$= \frac{\text{Hydraulic conductivity (K) X Hydraulic gradient (I)}}{\text{Effective porosity } (n_e)}$$

$$= \frac{0.01762 \text{ X } 0.00411}{0.3}$$

$$= \mathbf{2.4 \text{ X } 10^{-3} \text{ feet/day}}$$

Appendix D

Detailed Cost Estimate Information

Table D-1
Cost Estimate for Enhanced In-Situ Bioremediation and Groundwater Monitoring

Category/Task	Quantity	Unit Measure	Unit Rate	Estimated Cost
Site Work				
Mobilization of construction equipment and facilities	1	ls	$20,000.00	$20,000.00
Mobilization of personnel	1	ls	$2,600.00	$2,600.00
Utility clearance	5	dy	$1,200.00	$6,000.00
Monitoring well installation	3	ls	$4,000.00	$12,000.00
Monitoring well development	3	ea.	$1,200.00	$3,600.00
Geoprobe soil boring (application of ORC)	4	dy	$1,500.00	$6,000.00
ORC purchase	15000	lb	$8.50	$127,500.00
ORC shipping	15000	lb	$0.25	$3,750.00
Water quality monitoring system (oxygen meter)	1	ea	$6,000.00	$6,000.00
Organic vapor analyzer	1	ea	$3,700.00	$3,700.00
Soil cuttings disposal (3 drums per well)	3	ea	$500.00	$1,500.00
System start-up (5% of component installation)	1	ls	-	$8,127.50
Site Restoration				
Restore vegetation and planting	0.1	ac	$23,963.00	$2,396.30
Demobilization				
Demobilization of construction equipment and facilities	1	ls	$5,300.00	$5,300.00
Demobilization of personnel	1	ls	$2,600.00	$2,600.00
Removal of temporary facilities	1	ls	$350.00	$350.00
Installation report	1	ls	$15,000.00	$15,000.00
			Subtotal Project Costs	**$226,423.80**
Design and Engineering				
Estimated as 10 percent of subtotal project costs				$22,642.38
Site Safety and Health				
Estimated as 5 percent of subtotal project costs				$11,321.19
Construction Oversight				
Estimated as 10 percent of subtotal project costs				$22,642.38
Permitting				
Estimated as 5 percent of subtotal project costs				$11,321.19
Unlisted Items				
15 percent of subtotal project costs				$33,963.57
			Estimated Capital Cost	**$328,314.51**
Semiannual Operation and Maintenance (Groundwater Monitoring)				
Labor for monitoring (8 monitoring wells, 2 events)	16	hr	$52.00	$832.00
Laboratory analysis (2 events)	16	sample	$675.00	$10,800.00
Monitoring reporting	1	ls	$20,000.00	$20,000.00
			Estimated O&M Cost (annual)	**$31,632.00**
			Present Worth Value of O&M Cost at 5 Years	**$136,950.74**
			Total Present Worth Cost	**$465,265.25**

Table D-2
Cost Estimate for Excavation and Off-Site Disposal

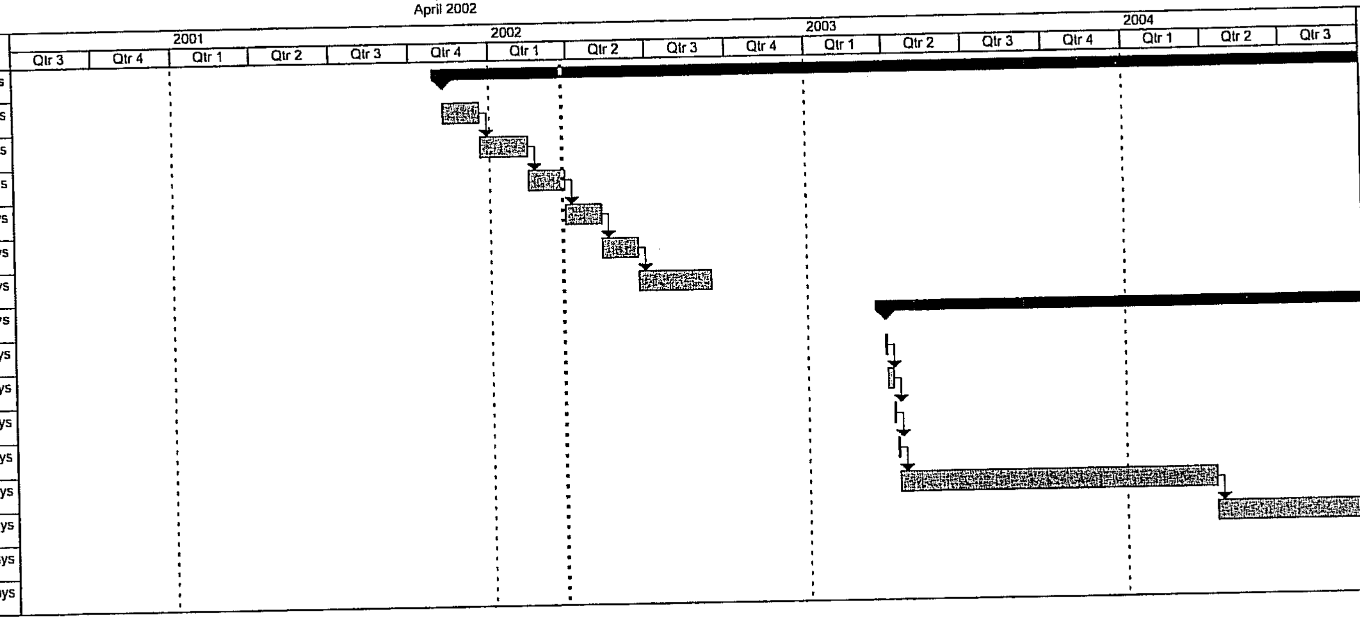
Category/Task	Quantity	Unit Measure	Unit Rate	Estimated Cost
Site Work				
Mobilization of Construction Equipment and Facilities	1	ls	-	$20,000.00
Mobilizaton of Personnel	1	ls	-	$2,600.00
Earthwork - soil excavation	6667	cy	$9.39	$62,603.13
Off-Site Contaminated Soil Disposal	6500	ton	$14.00	$91,000.00
Security, First Aid, Fire protection	1	ls	-	$4,400.00
Site Restoration				
Earthwork - backfilling	6667	cy	$12.75	$85,004.25
Restoration of Paved Areas	0	sy	$3.50	$0.00
Restore vegetation and planting (sod)	0.1	ac	$23,963.00	$2,396.30
Demobiliztion				
Demobilization of Construction Equipment and Facilities	1	ls	-	$5,300.00
Demobilizaton of Personnel	1	ls	-	$2,600.00
Removal of temporary facilities	1	ls	-	$350.00
Reporting	1	ls	-	$15,000.00
		Subtotal Project Costs		**$291,253.68**
Design and Engineering				
Estimated as 10 percent of subtotal project costs				$29,125.37
Site Safety and Health				
Estimated as 5 percent of subtotal project costs				$14,562.68
Construction Oversight				
Estimated as 10 percent of subtotal project costs				$29,125.37
Permitting				
Estimated as 5 percent of subtotal project costs				$14,562.68
Unlisted Items				
15 percent of subtotal project costs				$43,688.05
		Estimated Capital Cost		**$422,317.84**

Appendix E

Schedule of Implementation

Schedule for
GSA Hardesty Building 4 CAP
April 2002

ID	Task Name	Duration
1	**Building 4 Tanks CAP**	1705 days
2	Internal Draft CAP	30 days
3	GSA Review	40 days
4	Draft CAP	30 days
5	MO DNR Review	30 days
6	Final CAP	30 days
7	Preparation of Work Plans	60 days
8	**Field Work**	1313 days
9	Bioremediation Parameter Collection	2 days
10	Excavation	5 days
11	Remedial System Construction	2 days
12	Groundwater Monitoring Well Installation	2 days
13	Semiannual Monitoring and Reporting	260 days
14	Annual System Monitoring and Reporting	1040 days
15	Confirmation Sampling	2 days
16	Final Corrective Action Report	30 days



Date: Mon 3/25/02

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Split
External Tasks
Project Summary

Schedule for
GSA Hardesty Building 4 CAP
April 2002